

Test of Ekahau B4 Wi-Fi Location Tag

To: FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ROVN06-U1 Rev A



**TEST REPORT**  
FROM  
**MiCOMLabs**

Test of Ekahau B4 Wi-Fi Location Tag

to

To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ROVN06-U1 Rev A

This report supersedes: NONE

Applicant: Ekahau Inc.  
Hiilikatu 3  
00180 Helsinki  
Finland

Product Function: Wi-Fi Location Tag

Copy No: pdf Issue Date: 19th June 2012

**This Test Report is Issued Under the Authority of:**

**MiCOM Labs, Inc.**  
440 Boulder Court, Suite 200  
Pleasanton, CA 94566 USA  
Phone: +1 (925) 462-0304  
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[www.micomlabs.com](http://www.micomlabs.com)



TEST CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



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## ACCREDITATION, LISTINGS & RECOGNITION

### ACCREDITATION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) [www.a2la.org](http://www.a2la.org) test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



*The American Association for Laboratory Accreditation*

### *Accredited Laboratory*

A2LA has accredited

**MICOM LABS**

*Pleasanton, CA*

for technical competence in the field of

**Electrical Testing**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 27<sup>th</sup> day of March 2012.

President & CEO  
For the Accreditation Council  
Certificate Number 2381.01  
Valid to November 30, 2013



*For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.*

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## RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA\*\* countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	Listing #: 4143A-2
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	210
	VCCI	--	--	No. 2959
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

\*\*APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.

Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

N/A – Not Applicable

\*\*EU MRA – European Union Mutual Recognition Agreement.

Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

\*\*NB – Notified Body

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## **PRODUCT CERTIFICATION**

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. The company is accredited by the American Association for Laboratory Accreditation (A2LA) [www.a2la.org](http://www.a2la.org) test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-02.pdf>



*The American Association for Laboratory Accreditation*

*"World Class Accreditation"*

## ***Accredited Product Certification Body***

A2LA has accredited

**MICOM LABS**

*Pleasanton, CA*

for technical competence as a

**Product Certification Body**

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC Guide 65:1996 *General requirements for bodies operating product certification systems*. This accreditation demonstrates technical competence for a defined scope and the operation of a quality management system.

Presented this 27<sup>th</sup> day of March 2012.



  
President & CEO  
For the Accreditation Council  
Certificate Number 2381.02  
Valid to November 30, 2013

*For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation*

**United States of America – Telecommunication Certification Body (TCB)**  
TCB Identifier – US0159

**Industry Canada – Certification Body**  
CAB Identifier – US0159

**Europe – Notified Body**  
Notified Body Identifier - 2280

**Japan – Recognized Certification Body (RCB)**  
RCB Identifier - 210

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## DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	19 <sup>th</sup> June 2012	Initial Release

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## 1. TEST RESULT CERTIFICATE

Manufacturer:	Ekahau Inc. Hiilikatu 3 00180 Helsinki Finland	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Wi-Fi Location Tag	Telephone:	+1 925 462 0304
Model:	B4	Fax:	+1 925 462 0306
S/N's:	C1 00 12 88 BD 04 12		
Test Date(s):	2nd May 2012	Website:	<a href="http://www.micomlabs.com">www.micomlabs.com</a>

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247 & IC RSS-210	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

**Notes:**

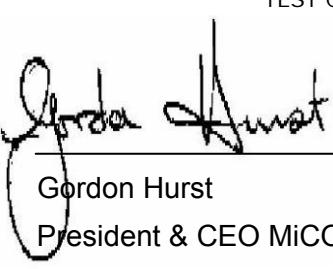
1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

**Approved & Released for MiCOM Labs, Inc. by:**



TEST CERTIFICATE #2381.01

  
Graeme Grieve  
Quality Manager MiCOM Labs,

  
Gordon Hurst  
President & CEO MiCOM Labs, Inc.

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## 2. REFERENCES AND MEASUREMENT UNCERTAINTY

### 2.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
i.	FCC 47 CFR Part 15, Subpart C	2012	Title 47: Telecommunication PART 15—RADIO FREQUENCY DEVICES Subpart C—Intentional Radiators
ii.	RSS-210 Annex 8	2010	Radio Standards Specification 210, Issue 8, Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
iii.	FCC OET KDB 662911	4 <sup>th</sup> April 2011	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
iv.	DA 00-705	2000	FCC DA 00-705 “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” released March 30, 2000
v.	RSS-GEN	2010	Radio Standards Specification-Gen, Issue 3, General Requirements and Information for the Certification of Radiocommunication Equipment
vi.	FCC 47 CFR Part 15, Subpart B	2010	47 CFR Part 15, SubPart B; Unintentional Radiators
vii.	ICES-003	2004	Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard Digital Apparatus; Issue 4
viii.	ANSI C63.4	2009	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ix.	CISPR 22/ EN 55022	2008 2006+A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
x.	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
xi.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
xii.	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
xiii.	A2LA	March 2012	Reference to A2LA Accreditation Status – A2LA Advertising Policy

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## 2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

### **3. PRODUCT DETAILS AND TEST CONFIGURATIONS**

#### **3.1. Technical Details**

Details	Description
Purpose:	Test of the EkaHau B4 Wi-Fi Location Tag to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Applicant:	EkaHau Inc. Hiilikatu 3 00180 Helsinki Finland
Manufacturer:	Incap Electronics Estonia OU Kuressaare factory, Tehnika 9 Kuressaare, EE-93815 Estonia.
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	ROVN06-U1 Rev A
Date EUT received:	2nd May 2012
Dates of test (from - to):	2nd May 2012
No of Units Tested:	Two (separate units for conducted and radiated)
Type of Equipment:	802.11b/g WIFI Location Tag
Transmit and Receive Chains:	1
Manufacturers Trade Name:	Incap Electronics
Model:	B4
Software / Hardware Release	C1 00 12 88 BD 04 12
Location for use:	Indoor
Frequency Range(s):	2,400 – 2,483.5 MHz
Modulation:	Per 802.11 –DSSS, OFDM
Client Declared Nominal Output Power (fixed):	802.11b: +12.0 dBm 802.11g: +12.0 dBm
Antenna Gain:	0 dBi
ITU Emission Designator:	2400 – 2483.5 MHz 802.11b      15M9G1D 2400 – 2483.5 MHz 802.11g      16M7D1D
Transmit/Receive Operation:	Legacy 802.11b/g, Half Duplex
Rated Input Voltage and Current:	3.3Vdc 1.1A
Operating Temperature Range:	Declared range -20° to +60°C
Long Term Frequency Stability:	±20 ppm
Equipment Dimensions	90 x 69 x 8 mm
Primary function of equipment:	WIFI Location Tag.

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### 3.2. Scope of Test Program

The scope of the test program was to test the EkaHau B4 WiFi Location Tag against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications in the frequency range 2400 - 2483.5 MHz.

**B4**  
**802.11 b/g/n WIFI Location Tag**



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### 3.3. EUT Configurations

#### Channel plan and spacing:

Band (GHz)	Mode	Freq Band (MHz)	Freq Range (MHz)	Low Ch	Mid Ch	High Ch	# Ch	Ch Spacing (MHz)
2.4	802.11 b	2400 - 2483.5	2412 - 2462	2412	2432	2462	11	20
2.4	802.11 g	2400 - 2483.5	2412 - 2462	2412	2432	2462	11	20

### 3.4. Equipment Details

The following is a description of supporting equipment used during the test program.

Equipment	Equipment Description	Manufacturer	Model No.	Serial No (s).	Tested
Computer	Laptop	IBM			

### 3.5. Test Configurations

Operational Mode(s)	Data Rate Tested	Duty Cycle (Tx Radiated Emissions/ Conducted Emissions)	Duty Cycle (Rx Radiated Emissions)
b	1 MBit/s	100%	10%
g	6 MBit/s	100%	10%

### 3.6. Equipment Modifications

1. NONE

### 3.7. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

### 3.8. Subcontracted Testing or Third Party Data

The following subcontracted testing was required in order to complete the test program:

1. NONE



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#### **4. TEST SUMMARY**

##### **List of Measurements**

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
<b>15.247(a)(2)</b> <b>A8.2(1)</b> <b>4.4</b>	6 dB and 99 % Bandwidths	≥500 kHz	Conducted	Complies	5.1.1
<b>15.247(b)(3)</b> <b>15.31(e)</b> <b>A8.4(4)</b>	Peak Output Power Voltage Variation	Shall not exceed 1W  Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
<b>15.247(e)</b> <b>A8.2</b>	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
<b>15.247(i)</b> <b>5.5</b>	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
<b>15.247(d)</b> <b>15.205 /</b> <b>15.209</b> <b>A8.5</b> <b>2.2</b> <b>4.7</b>	Spurious Emissions (30MHz - 26 GHz b/g and 30 MHz – 40 GHz a)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	5.1.5

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### List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247**, **Industry Canada RSS-210**, and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
<b>15.247(d)</b> <b>15.205 /</b> <b>15.209</b> <b>A8.5</b> <b>2.2</b> <b>2.6</b> <b>4.7</b>	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.6.1
	Radiated Band Edge	Band-edge results		Complies	5.1.6.2.
	Peak Emissions				
Industry Canada only <b>RSS-Gen</b> <b>§4.10, §6</b>	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.6.3
<b>15.205 /</b> <b>15.209</b> <b>2.2</b>	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	5.1.6.4
<b>15.207</b> <b>7.2.2</b>	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	5.1.7

**Note 1:** Test results reported in this document relate only to the items tested

**Note 2:** The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

**Note 3:** Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

## 5. TEST RESULTS

### 5.1. Device Characteristics

#### 5.1.1. 6 dB and 99 % Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)

Industry Canada RSS-210 §A8.2

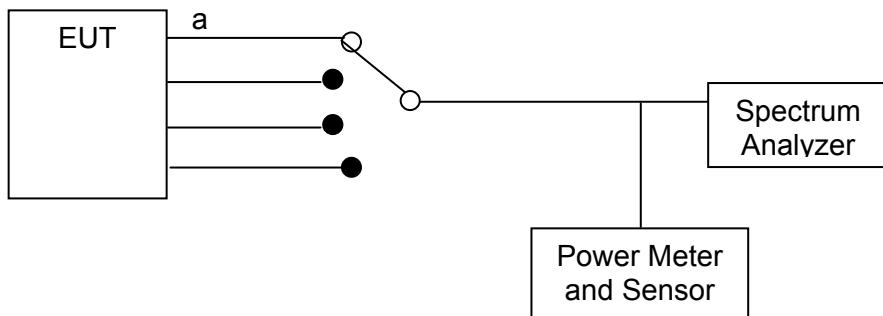
Industry Canada RSS-Gen §4.4

#### Test Procedure

The test methodology and conditions utilized for each measurement is referenced in the following test results matrix. 6 dB and 99% bandwidth were measured per the Test Configuration identified below.

Testing was restricted to a single port.

#### Test Configuration



Test setup for 6 dB & 99% Bandwidth

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**6dB & 99% Occupied Bandwidth – 801.11b**

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11b	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	0 dBi
<b>Applied Voltage:</b>	3.30 Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

***6 dB Bandwidth***

<b>Test Frequency</b>	<b>6 dB Bandwidth</b>				<b>Minimum 6dB Bandwidth Limit</b>		<b>Margin</b>
	<b>MHz</b>						
<b>MHz</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>kHz</b>	<b>MHz</b>	<b>MHz</b>
2412.000	10.100000	--	--	--	500	0.5	-9.600000
2437.000	10.180000	--	--	--			-9.680000
2462.000	10.100000	--	--	--			-9.600000

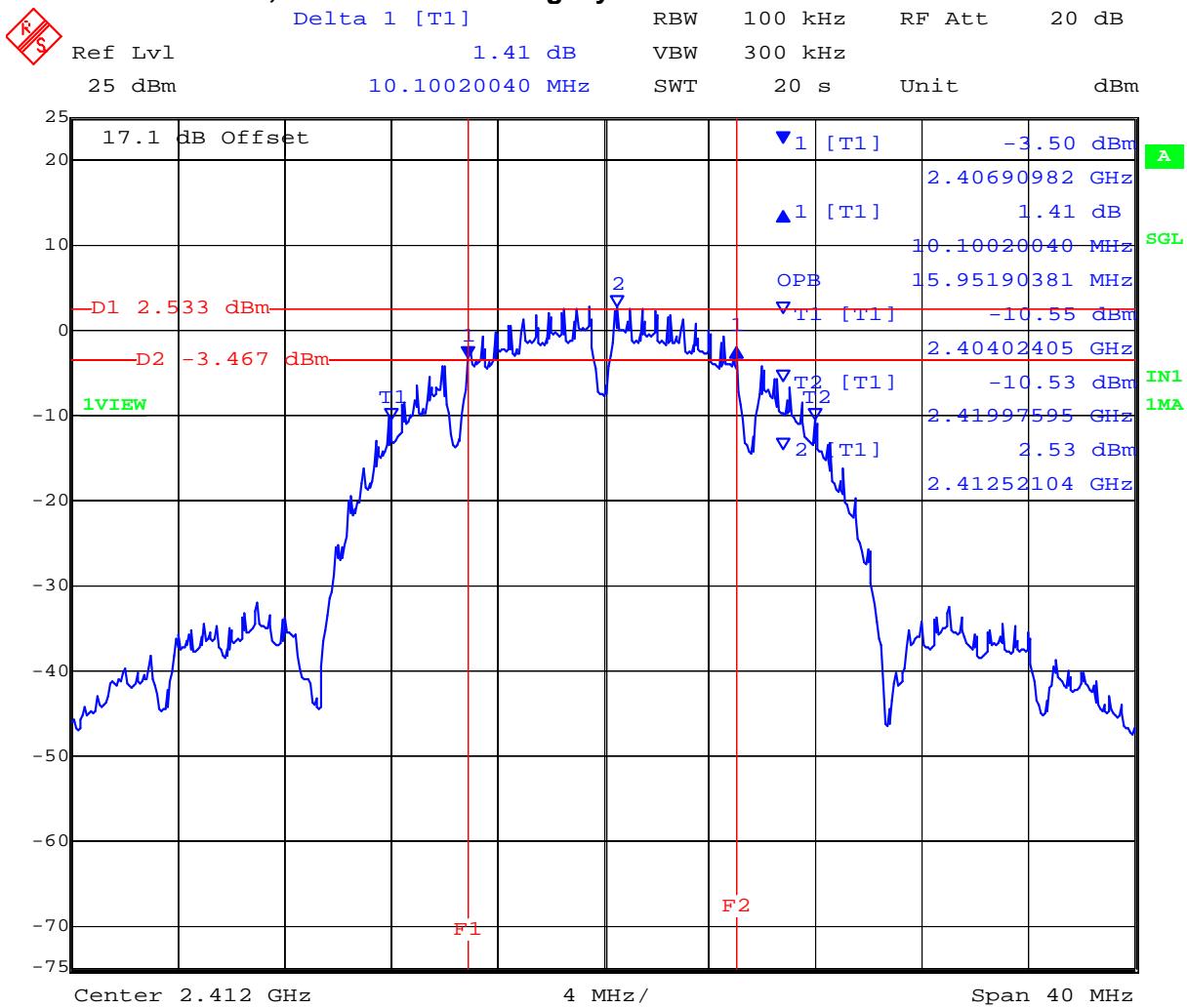
***99% Bandwidth***

<b>Test Frequency</b>	<b>99 % Bandwidth</b>						
	<b>MHz</b>						
<b>MHz</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>			
2412.000	15.952000	--	--	--			
2437.000	15.952000	--	--	--			
2462.000	15.952000	--	--	--			

<b>Measurement uncertainty:</b>	±2.81 dB
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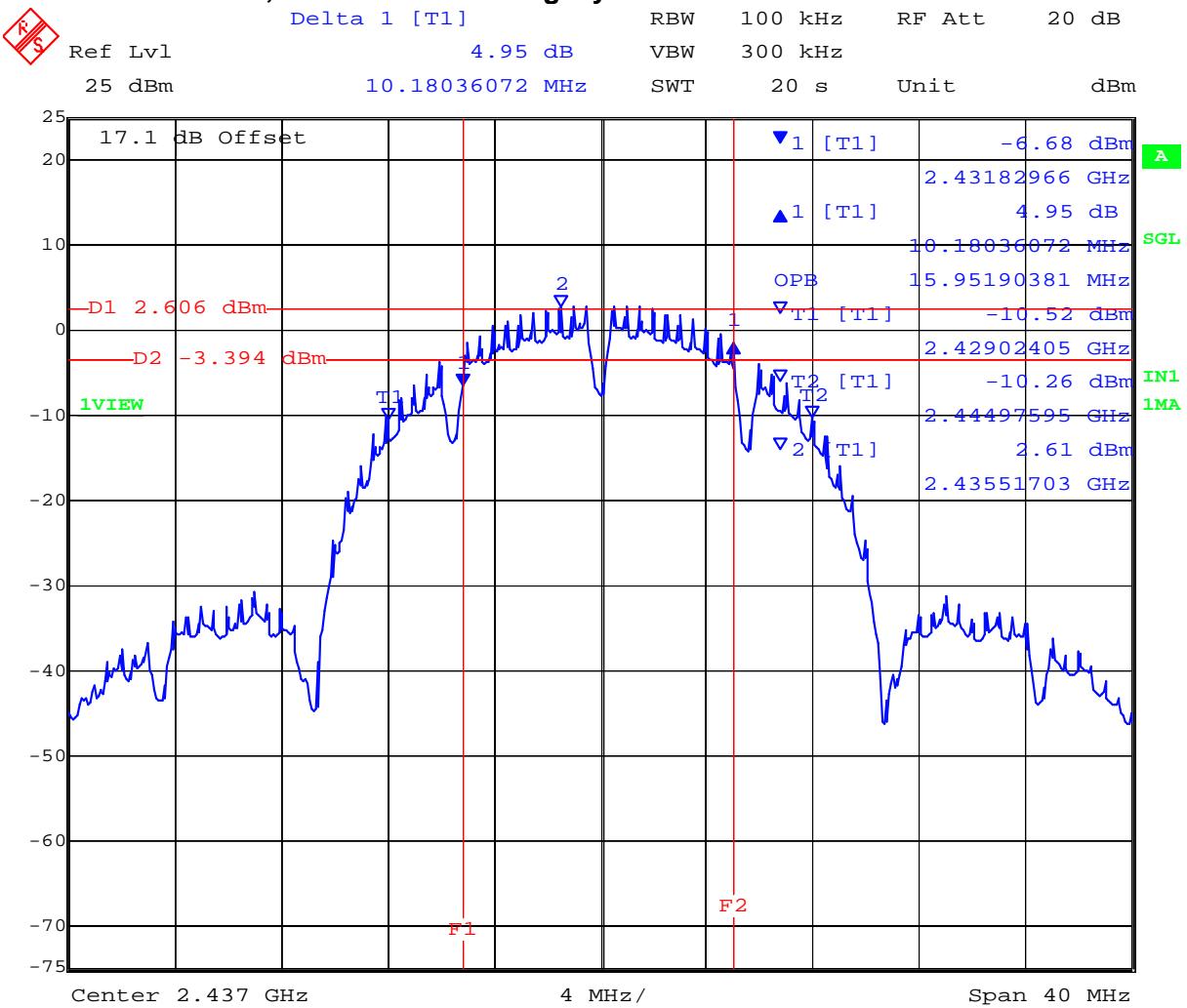
**2,412 MHz 802.11b Legacy 6 dB and 99% Bandwidth**



Date: 1.MAY.2012 10:03:59

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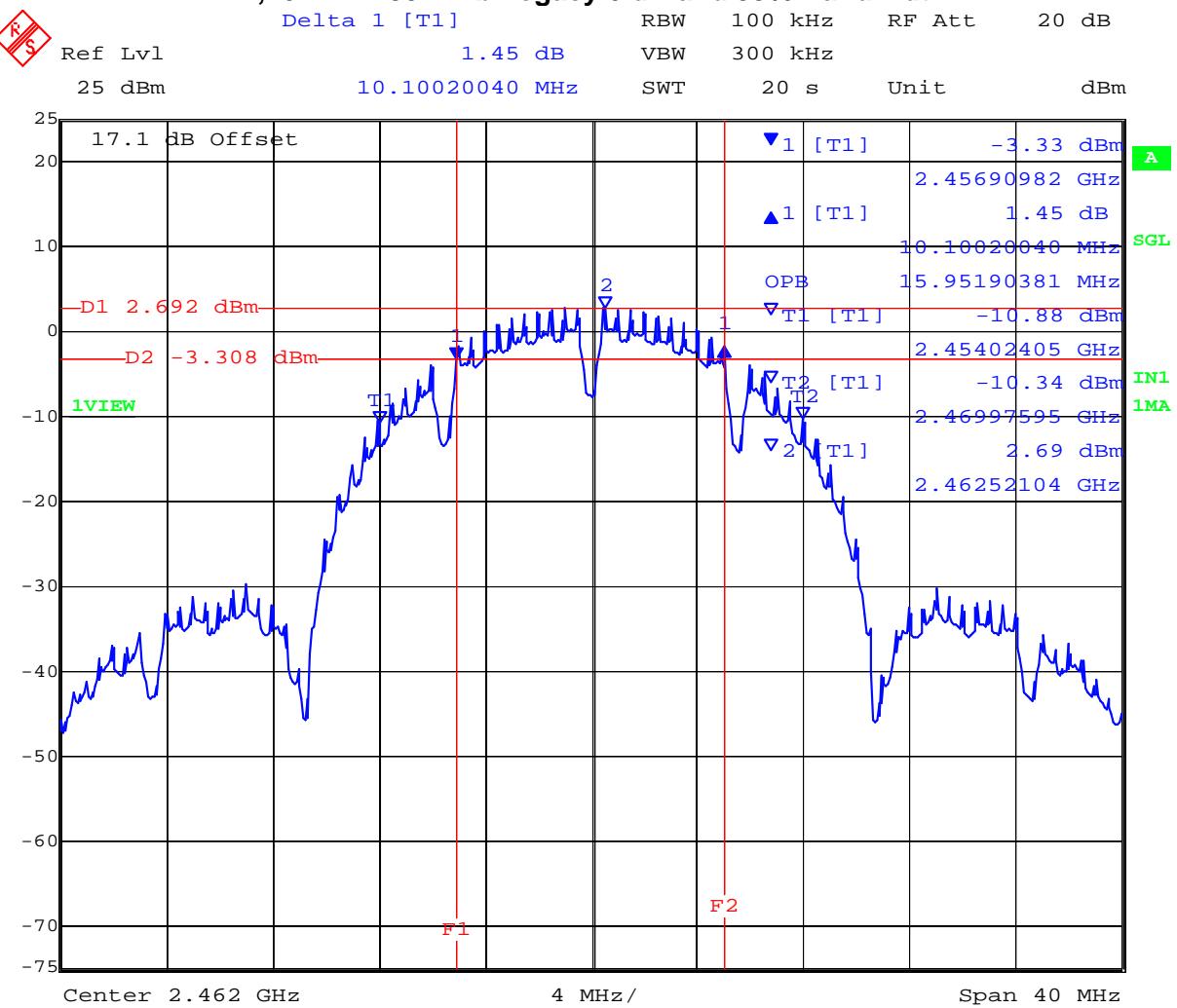
**2,437 MHz 802.11b Legacy 6 dB and 99% Bandwidth**



Date: 1.MAY.2012 10:16:24

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## 2,462 MHz 802.11b Legacy 6 dB and 99% Bandwidth



Date: 2.MAY.2012 11:44:50

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**6dB & 99% Occupied Bandwidth – 801.11g**

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11g	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	0 dBi
<b>Applied Voltage:</b>	3.30 Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

***6 dB Bandwidth***

<b>Test Frequency</b>	<b>6 dB Bandwidth</b>				<b>Minimum 6dB Bandwidth Limit</b>		<b>Margin</b>
	<b>MHz</b>						
<b>MHz</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>kHz</b>	<b>MHz</b>	<b>MHz</b>
2412.000	16.353000	--	--	--	500	0.5	-15.853000
2437.000	16.353000	--	--	--			-15.853000
2462.000	16.353000	--	--	--			-15.853000

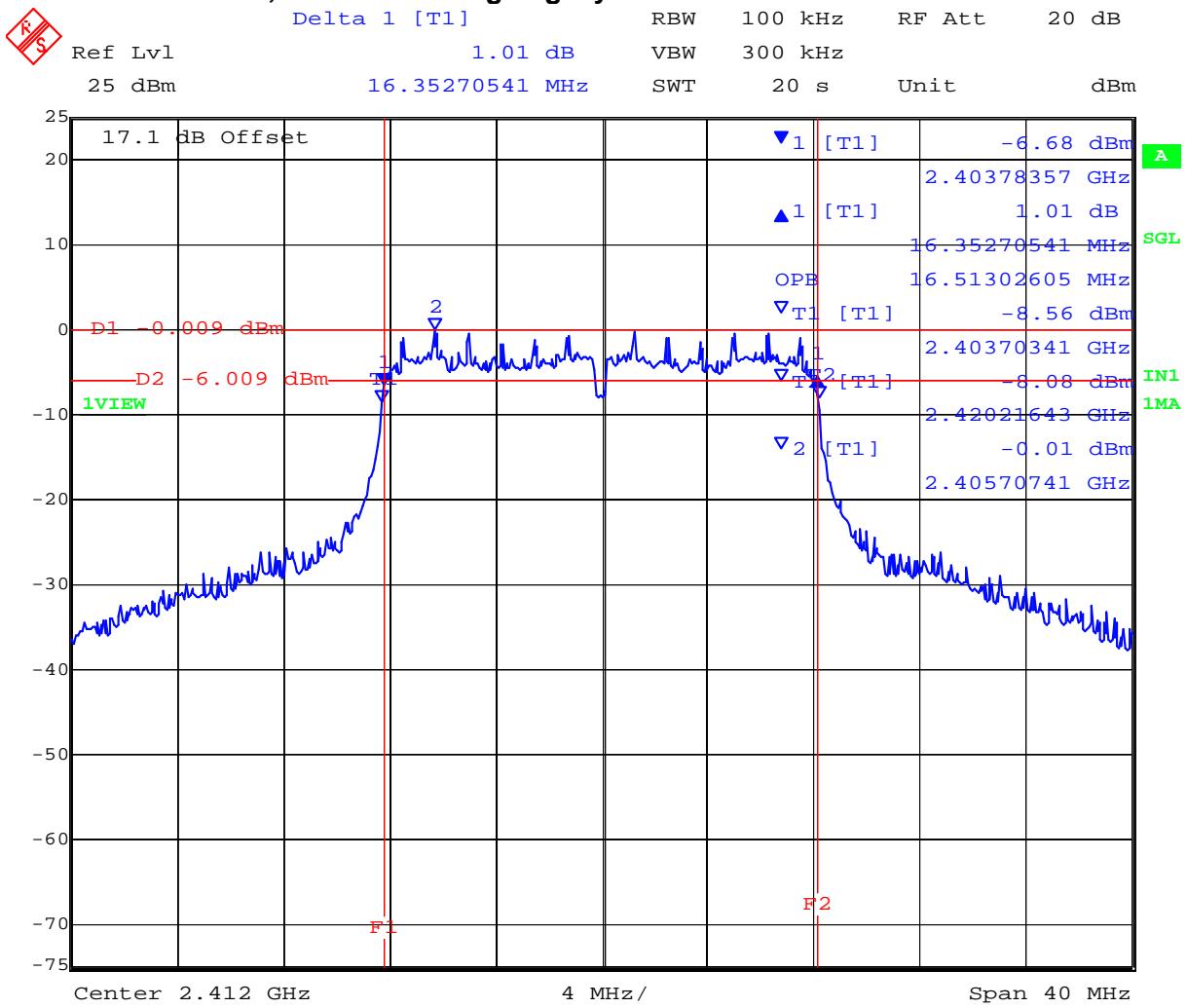
***99% Bandwidth***

<b>Test Frequency</b>	<b>99 % Bandwidth</b>						
	<b>MHz</b>						
<b>MHz</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>			
2412.000	16.513000	--	--	--			
2437.000	16.673000	--	--	--			
2462.000	16.673000	--	--	--			

<b>Measurement uncertainty:</b>	<b>±2.81 dB</b>
---------------------------------	-----------------

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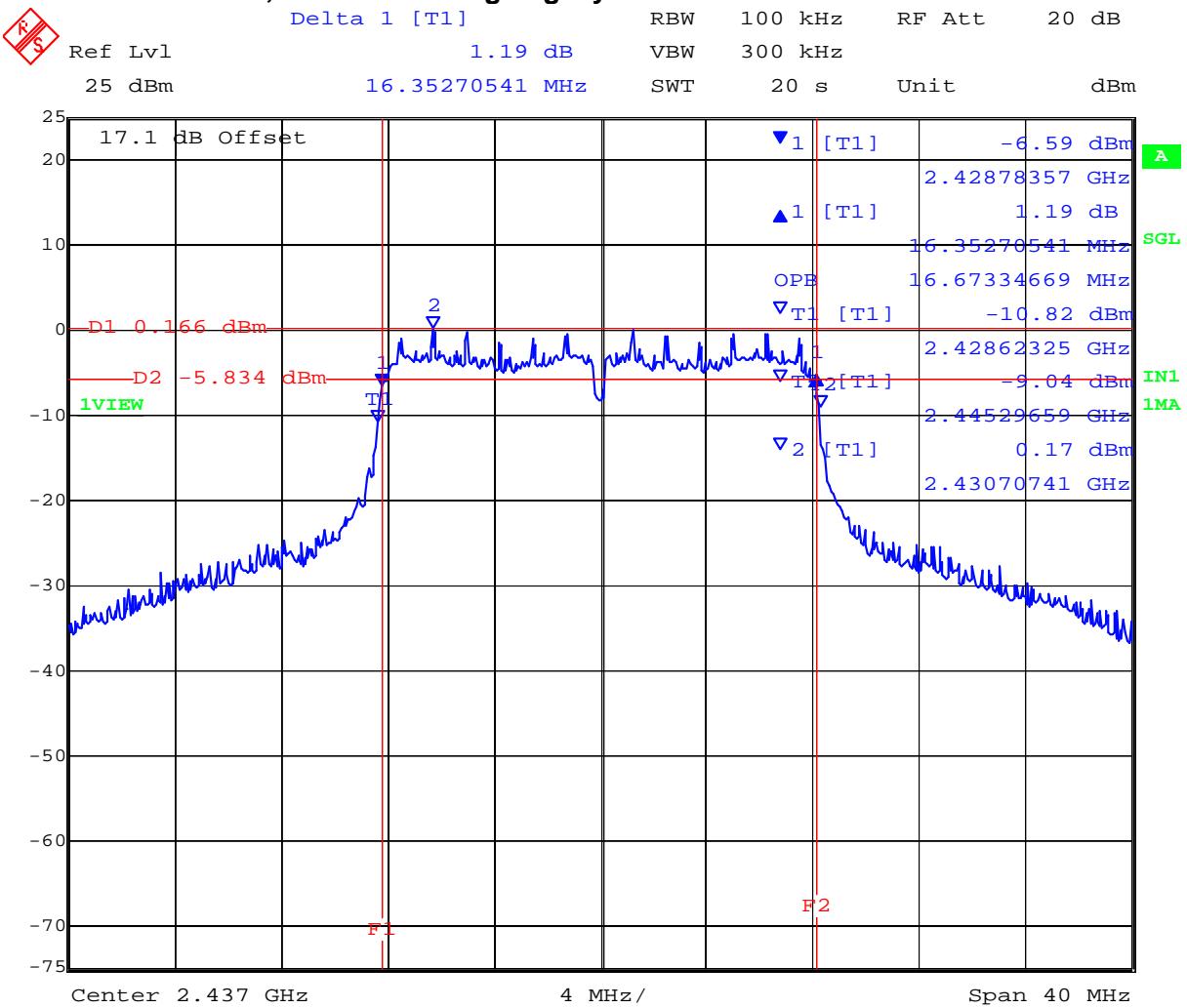
**2,412 MHz 802.11g Legacy 6 dB and 99% Bandwidth**



Date: 1.MAY.2012 12:00:24

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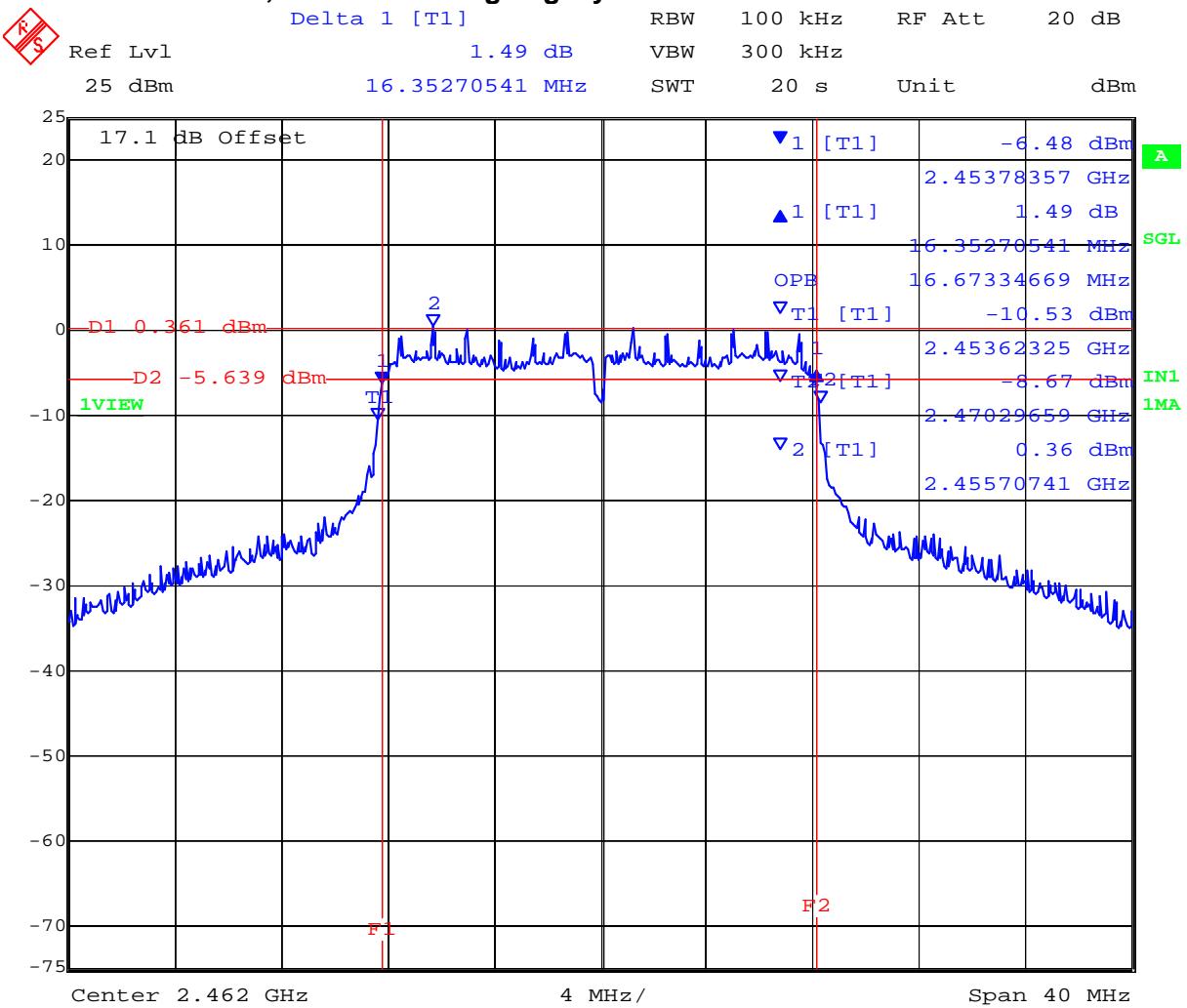
**2,437 MHz 802.11g Legacy 6 dB and 99% Bandwidth**



Date: 1.MAY.2012 12:13:56

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**2,462 MHz 802.11g Legacy 6 dB and 99% Bandwidth**



Date: 1.MAY.2012 12:22:38

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## Specification

### Limits

**§15.247 (a)(2) & RSS-210 §A8.2(1)**

The minimum 6 dB bandwidth shall be at least 500 kHz.

**§ IC RSS-Gen 4.4.1 Occupied Bandwidth** When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

**§ IC RSS-Gen 4.4.2 6 dB Bandwidth** Where indicated, the 6 dB bandwidth is measured at the points when the spectral density of the signal is 6 dB down from the in –band spectral density of the modulated signal, with the transmitter modulated by a representative signal.

## Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB
-------------------------	----------

### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

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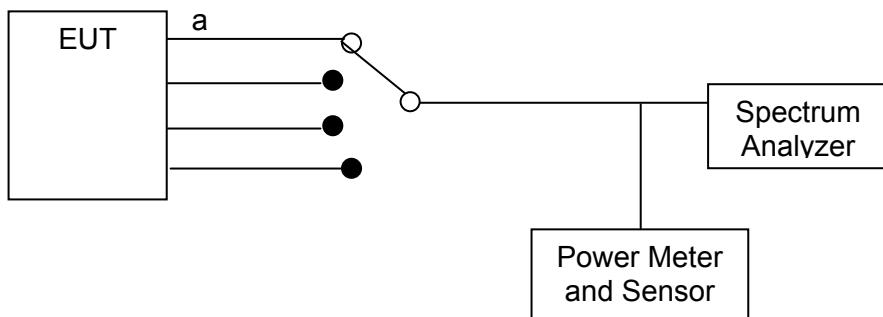
### 5.1.2. Peak Output Power

**FCC, Part 15 Subpart C §15.247(b)(3), §15.31(e)**  
**Industry Canada RSS-210 §A8.4(4)**

#### Test Procedure

The test methodology and conditions utilized for each measurement is referenced in the test results matrix. The average output power was measured per the test configuration identified below. Per the standard measurements were taken at ambient conditions, nominal voltage.

#### Test Configuration



Measurement setup for Peak Output Power

Note: Antenna Gain = 0dBi.

---

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**Title:** Ekahau B4 Wi-Fi Location Tag  
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**Peak Conducted Output Power – 802.11b**

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11b	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	0 dBi
<b>Applied Voltage:</b>	3.30 Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

<b>Test Frequency</b>	<b>Measured Peak Power</b>				<b>Total Power (dBm)</b>		<b>Limit</b>	<b>Margin</b>
	<b>RF Port (dBm)</b>							
<b>MHz</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>Combined</b>	<b>Calculated</b>	<b>dBm</b>	<b>dB</b>
2412	11.67	--	--	--	N/A	11.67	30.00	-18.33
2437	12.03	--	--	--	N/A	12.03	30.00	-17.97
2462	12.10	--	--	--	N/A	12.10	30.00	-17.90

<b>Measurement uncertainty:</b>	±1.33 dB
---------------------------------	----------

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**Title:** Ekahau B4 Wi-Fi Location Tag  
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### Peak Conducted Output Power – 802.11q

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11g	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain (Y):</b>	N/A	<b>Antenna Gain:</b>	0	dBi	
<b>Applied Voltage:</b>	3.30	Vdc			
<b>Notes 1:</b>					
<b>Notes 2:</b>					

<b>Test Frequency</b>	<b>Measured Peak Power</b>				<b>Total Power (dBm)</b>		<b>Limit</b>	<b>Margin</b>
	<b>RF Port (dBm)</b>							
<b>MHz</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>Combined</b>	<b>Calculated</b>	<b>dBm</b>	<b>dB</b>
2412	10.34	--	--	--	N/A	10.34	30.00	-19.66
2437	10.64	--	--	--	N/A	10.64	30.00	-19.36
2462	10.84	--	--	--	N/A	10.84	30.00	-19.16

<b>Measurement uncertainty:</b>	±1.33 dB
---------------------------------	----------

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## Specification

### Limits

**§15.247 (b)** The maximum peak output power of the intentional radiator shall not exceed the following:

**§15.247 (b) (3)** For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1.0 watt.

**15.247 (b) (4)** The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

15.247 (c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

**§15.31 (e)** For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

**§ RSS-210 A8.4(4)** For systems employing digital modulation techniques operating in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands the maximum peak conducted power shall not exceed 1 watt.

### Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB
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### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

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### **5.1.3. Peak Power Spectral Density**

**FCC, Part 15 Subpart C §15.247(e)**  
**Industry Canada RSS-210 §A8.2**

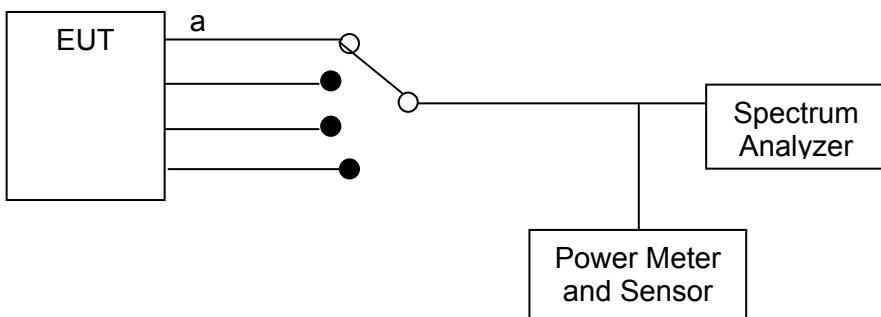
#### **Test Procedure**

The test methodology and conditions utilized for each measurement is referenced in the following test results matrix. RF output power, transmit power control and power density were measured per the Test Configuration identified below.

Testing was performed on the highest and lowest power settings of the equipment.

Per the standard measurements were taken at ambient and extreme temperature conditions at nominal and extreme voltage levels.

#### **Test Configuration**



Measurement setup for Peak Power Spectral Density

#### **Measurement Results for Peak Power Spectral Density**

---

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### Peak Power Spectral Density – 802.11b

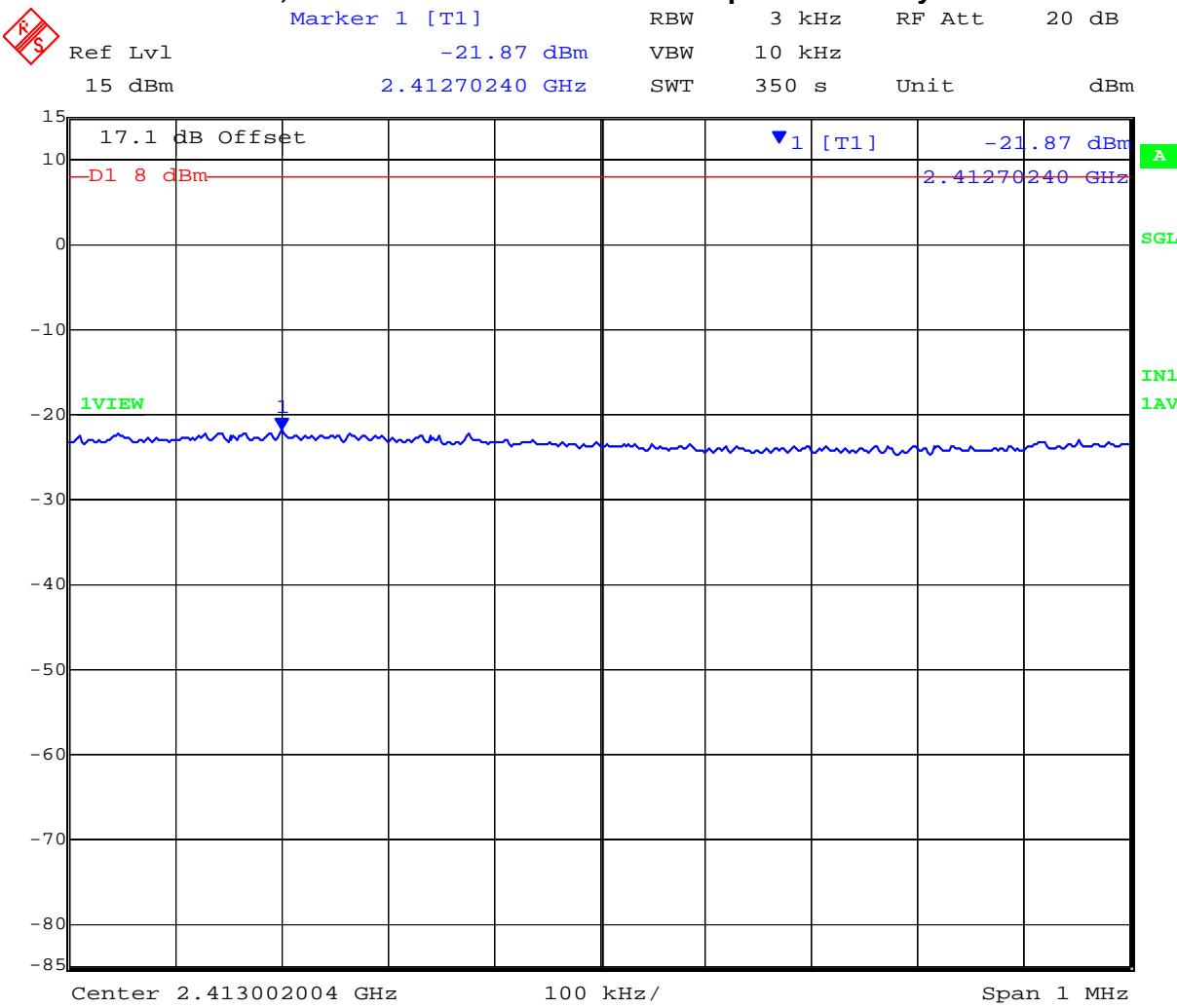
<b>Test Conditions:</b>	15.247 (e)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11b	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	0 dBi		
<b>Applied Voltage:</b>	3.30 Vdc	<b>Antenna Ports (N):</b>	1		
<b>Notes 1:</b>					
<b>Notes 2:</b>					

<b>Test Frequency</b>	<b>Measured Power Density</b>				<b>Correction factor</b>	<b>Peak Power Spectral Density</b>	<b>Limit</b>	<b>Margin</b>
	<b>RF Port (dBm)</b>							
<b>MHz</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>10Log(N)</b>	<b>dBm</b>	<b>dBm</b>	<b>dB</b>
2412.000	-21.87	--	--	--	0.00	-21.87	8.00	-29.87
2437.000	-21.57	--	--	--	0.00	-21.57	8.00	-29.57
2462.000	-21.28	--	--	--	0.00	-21.28	8.00	-29.28

<b>Measurement uncertainty:</b>	± 1.33 dB
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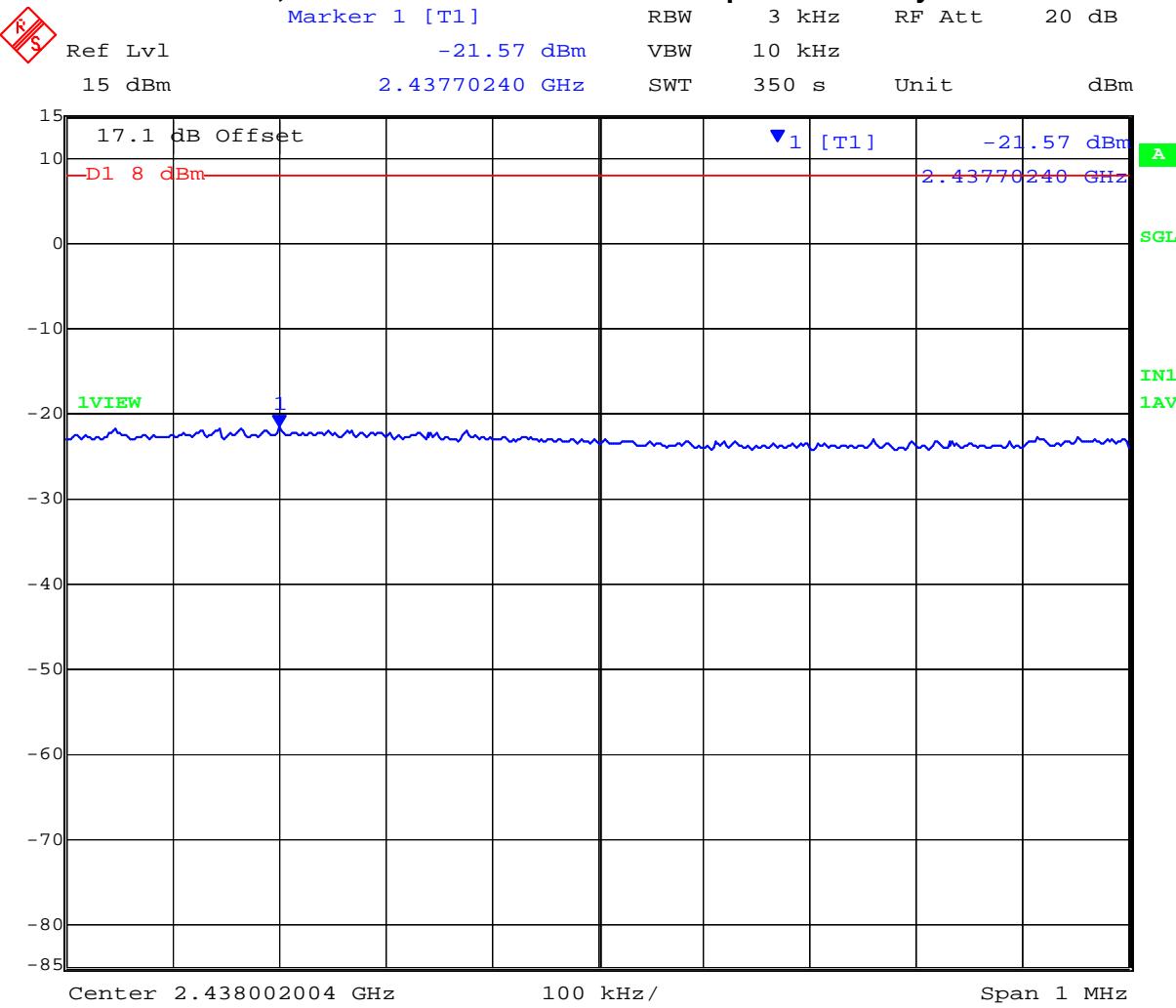
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**2,412 MHz 802.11b - Peak Power Spectral Density**



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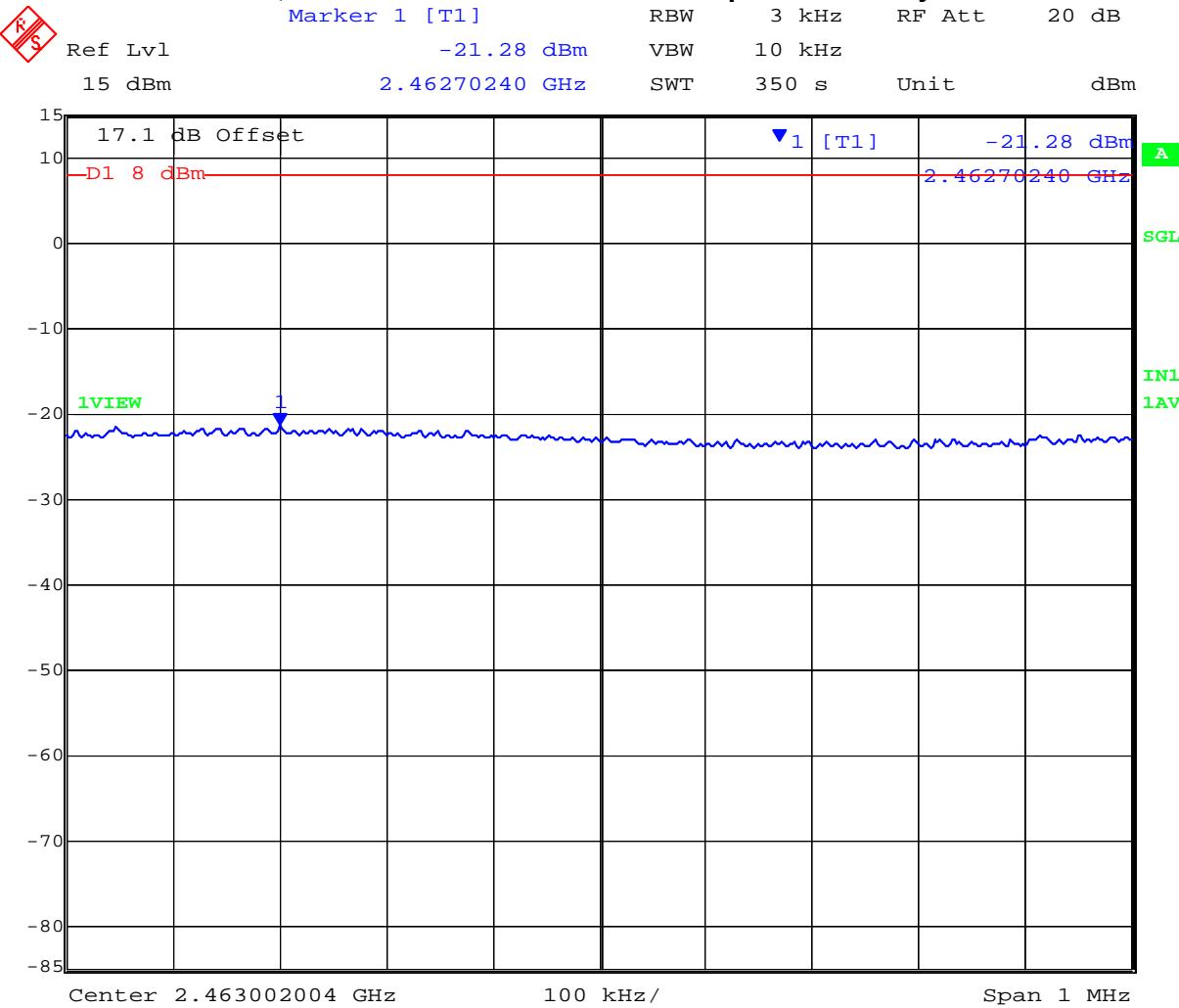
**2,437 MHz 802.11b - Peak Power Spectral Density**



Date: 1.MAY.2012 16:10:04

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**2,462 MHz 802.11b - Peak Power Spectral Density**



Date: 1.MAY.2012 15:54:44

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### Peak Power Spectral Density – 802.11q

<b>Test Conditions:</b>	15.247 (e)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11g	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	0 dBi
<b>Applied Voltage:</b>	3.30 Vdc	<b>Antenna Ports (N):</b>	1
<b>Notes 1:</b>			
<b>Notes 2:</b>			

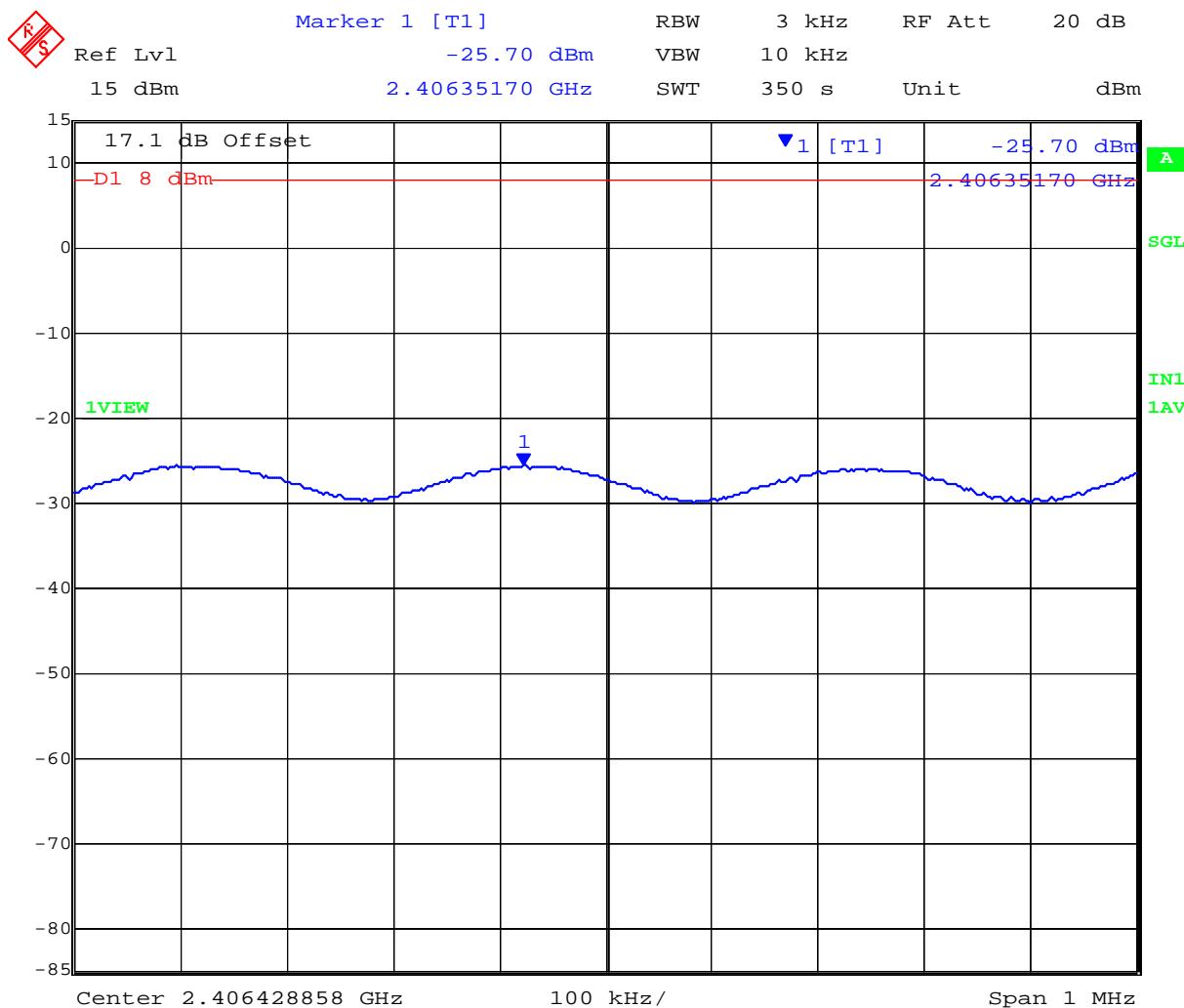
<b>Test Frequency</b>	<b>Measured Power Density</b>				<b>Correction factor</b>	<b>Peak Power Spectral Density</b>	<b>Limit</b>	<b>Margin</b>
	<b>RF Port (dBm)</b>							
<b>MHz</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>10Log(N)</b>	<b>dBm</b>	<b>dBm</b>	<b>dB</b>
2412.000	-25.70	--	--	--	0.00	-25.70	8.00	-33.70
2437.000	-25.62	--	--	--	0.00	-25.62	8.00	-33.62
2462.000	-22.95	--	--	--	0.00	-22.95	8.00	-30.95

**Measurement uncertainty:**

± 1.33 dB

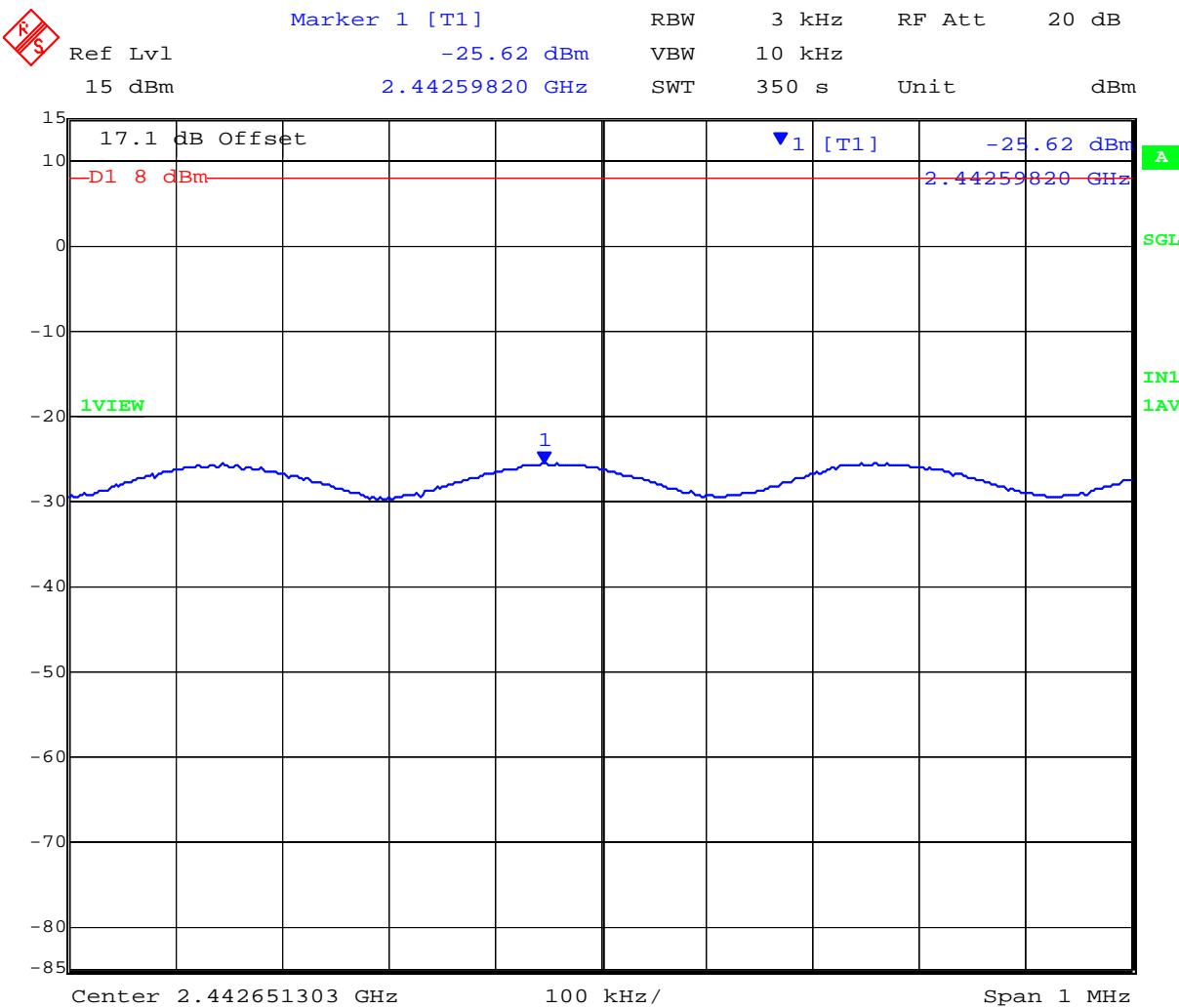
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### 2,412 MHz 802.11g Legacy - Peak Power Spectral Density



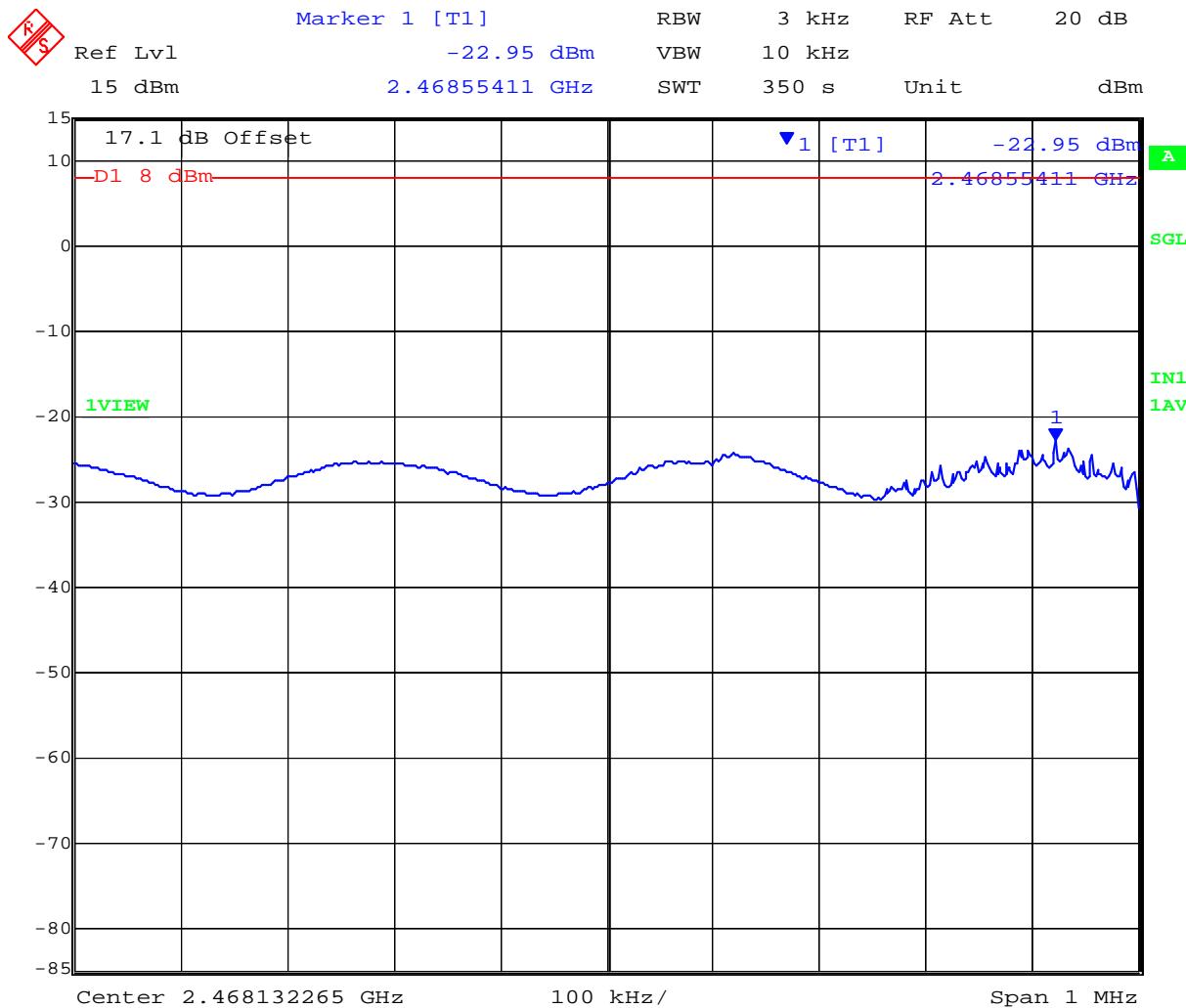
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**PORT A 2,437 MHz 802.11g Legacy - Peak Power Spectral Density**



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**PORT A 2,462 MHz 802.11g Legacy - Peak Power Spectral Density**



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## Specification

### Peak Power Spectral Density Limits

**§15.247(e)** For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission

**RSS-210 §A8.2(2)** The transmitter power spectral density (into the antenna) shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

### Laboratory Measurement Uncertainty for Spectral Density

Measurement uncertainty	±1.33 dB
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### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

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#### 5.1.4. Maximum Permissible Exposure

**FCC, Part 15 Subpart C §15.247(i)**  
**Industry Canada RSS-Gen §5.5**

##### Calculations for Maximum Permissible Exposure Levels

$$\text{Power Density} = P_d \text{ (mW/cm}^2\text{)} = \text{EIRP}/(4\pi d^2)$$

$$\text{EIRP} = P * G$$

$$P = \text{Peak output power (mW)}$$

$$G = \text{Antenna numeric gain (numeric)}$$

$$d = \text{Separation distance (cm)}$$

$$\text{Numeric Gain} = 10 ^ (G \text{ (dBi)}/10)$$

The Aruba AP-104 has two transmitters operating in each band. The peak power in the table below is calculated by assuming a worst case scenario where the two transmitters are operating simultaneously in the same band. The Peak Power in mW is calculated by taking the maximum allowable conducted power measured in each band from both antennas.

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm<sup>2</sup>

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Power Density (S) (mW/cm <sup>2</sup> )	Minimum Separation Distance (cm)
2.4	0	1	+12.10	16.22	0.003	20.0*

\*Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

#### Specification

##### Maximum Permissible Exposure Limits

**§15.247(i)** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines.

**FCC §1.1310** Limit = 1mW / cm<sup>2</sup> from 1.310 Table 1

**RSS-Gen §5.5** Before equipment certification is granted, the applicable requirements of RSS-102 shall be met

#### Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB
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### **5.1.5. Conducted Spurious Emissions**

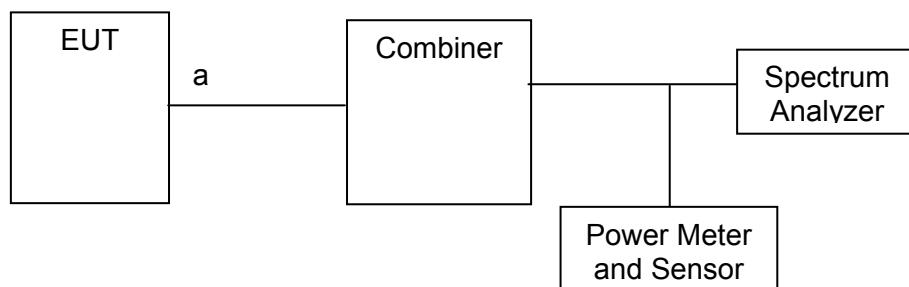
**FCC, Part 15 Subpart C §15.247(d); 15.205; 15.209**  
**Industry Canada RSS-210 §A8.5, §2.2**  
**Industry Canada RSS-Gen 4.7**

#### **Test Procedure**

Conducted emissions were measured at a limit of 30 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

Measurements were made using a combiner with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the peak emission.

#### **Test Configuration**



Measurement setup for Conducted Spurious Emission

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### Conducted Band-Edge Results

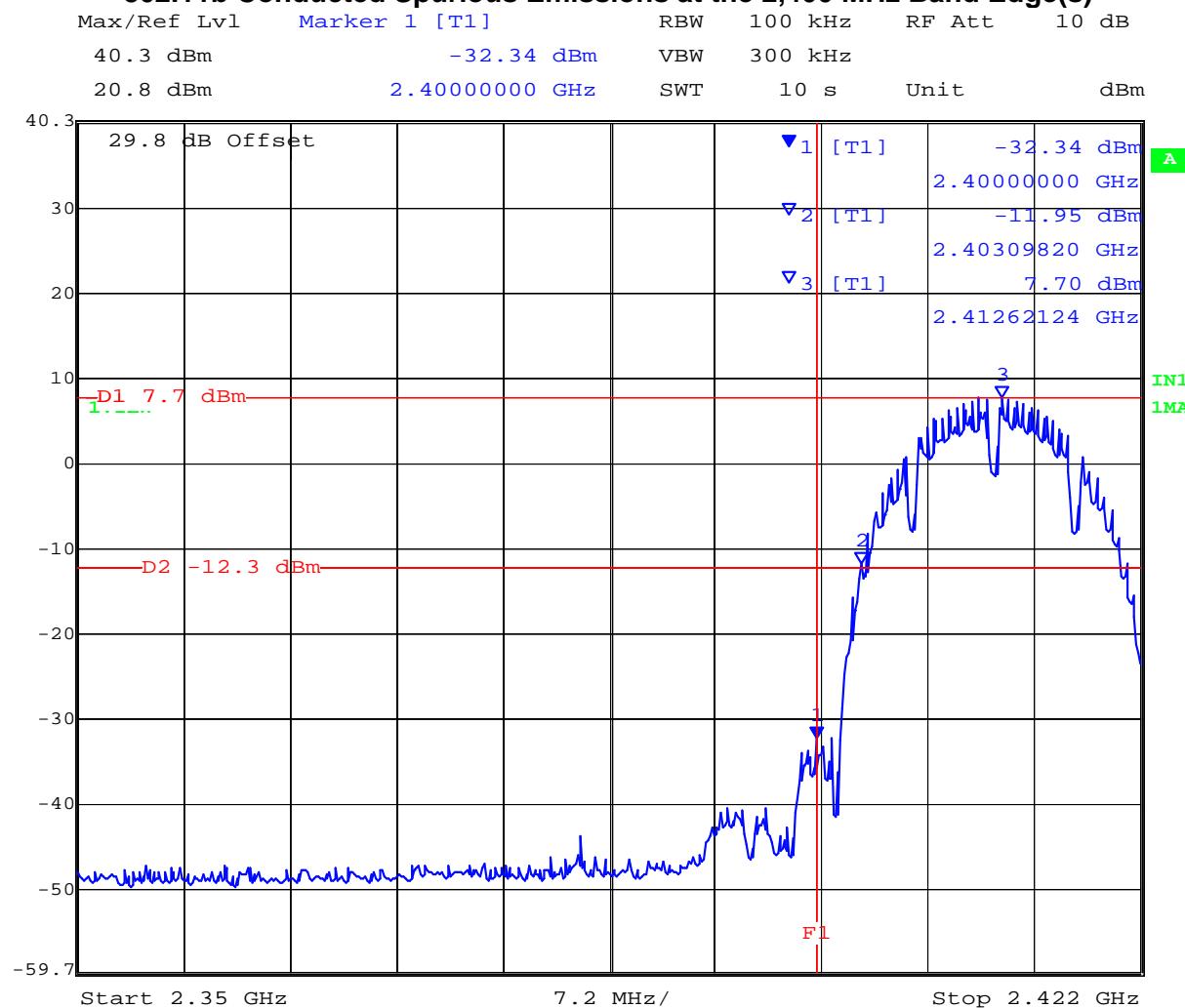
Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. Limits which were derived from the band-edge measurements provided below are drawn on each plot.

TABLE OF RESULTS – 802.11b

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2412	2,400	-12.30	-32.34	-20.04
2462	2,483.5	-12.56	-47.92	-35.36

### Lower Band Edge

#### 802.11b Conducted Spurious Emissions at the 2,400 MHz Band Edge(s)



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### Upper Band Edge

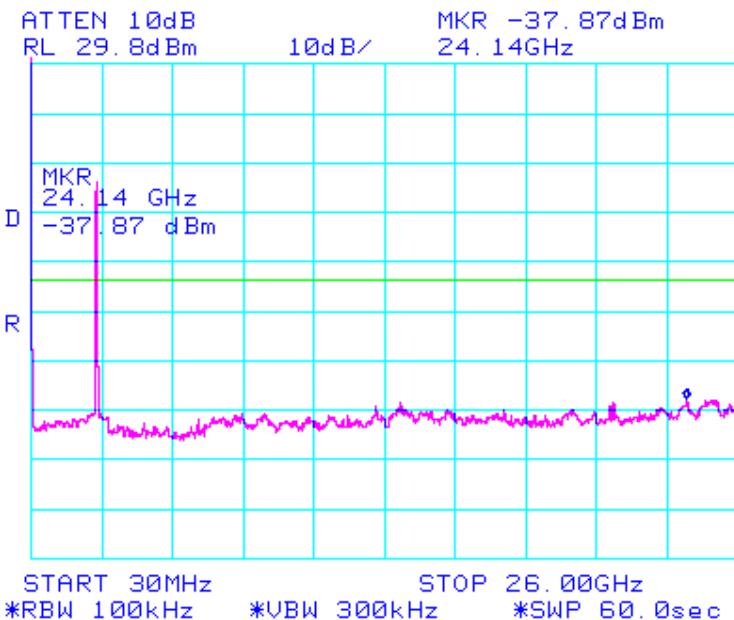
#### 802.11b Conducted Spurious Emissions at the 2483.5 MHz Band Edge(s)



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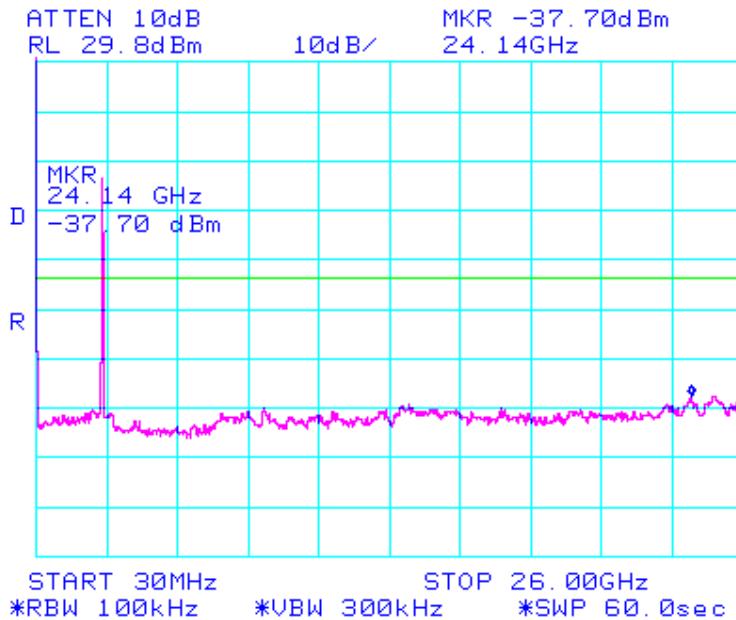
Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2412	30	26,000	-37.87	-12.30	-25.57
2437	30	26,000	-37.70	-12.66	-25.04
2462	30	26,000	-37.87	-12.56	-25.31

## 802.11b 2412 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz

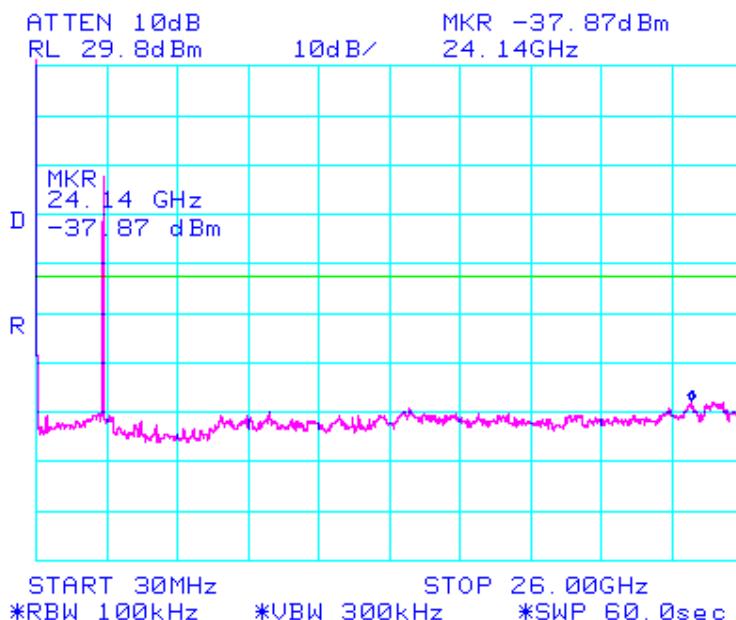


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## 802.11b 2,437 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



802.11b 2,462 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



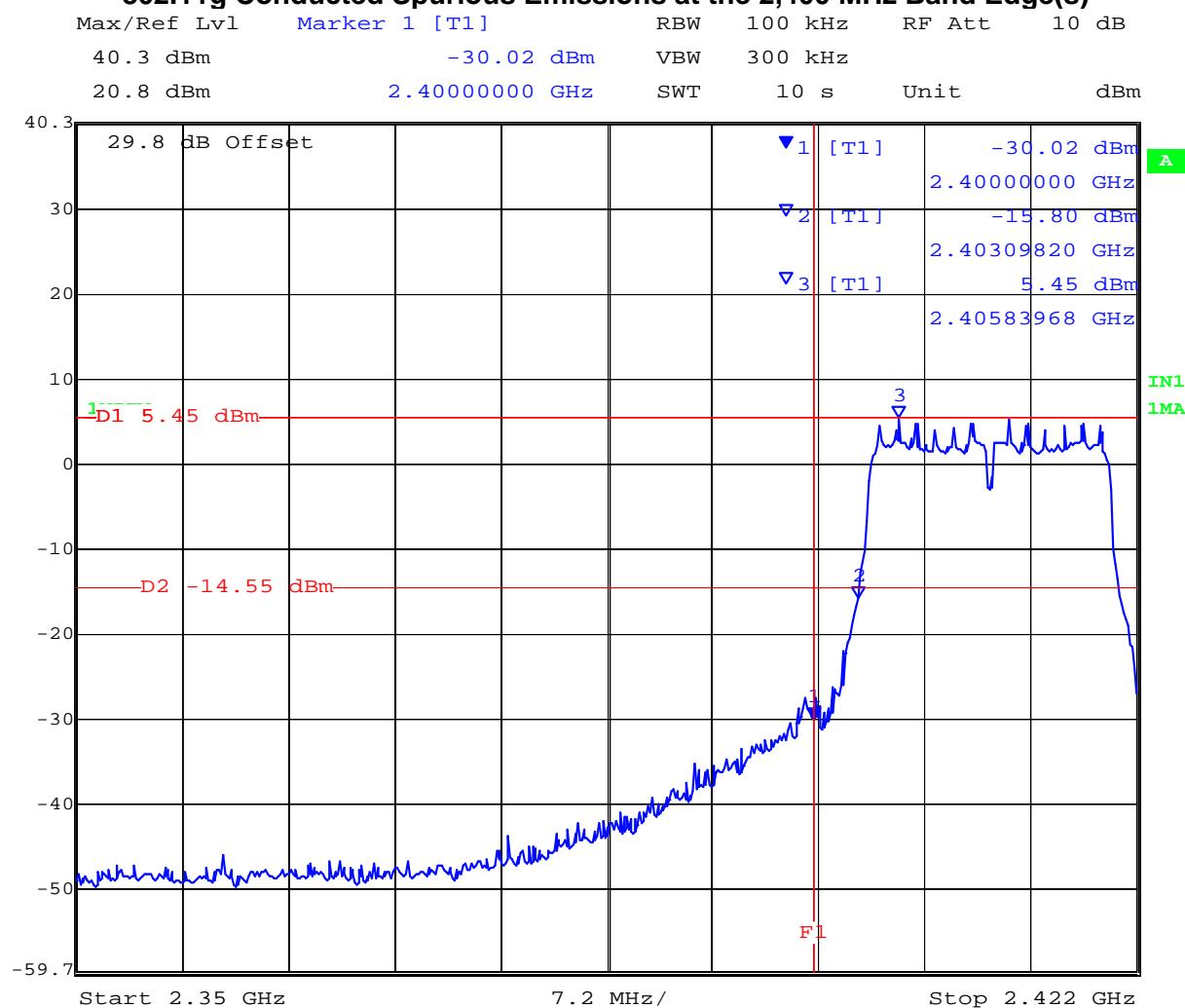
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TABLE OF RESULTS – 802.11g

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2412	2,400	-14.55	-30.02	-15.47
2462	2,483.5	-14.85	-41.64	-26.79

**Lower Band Edge**

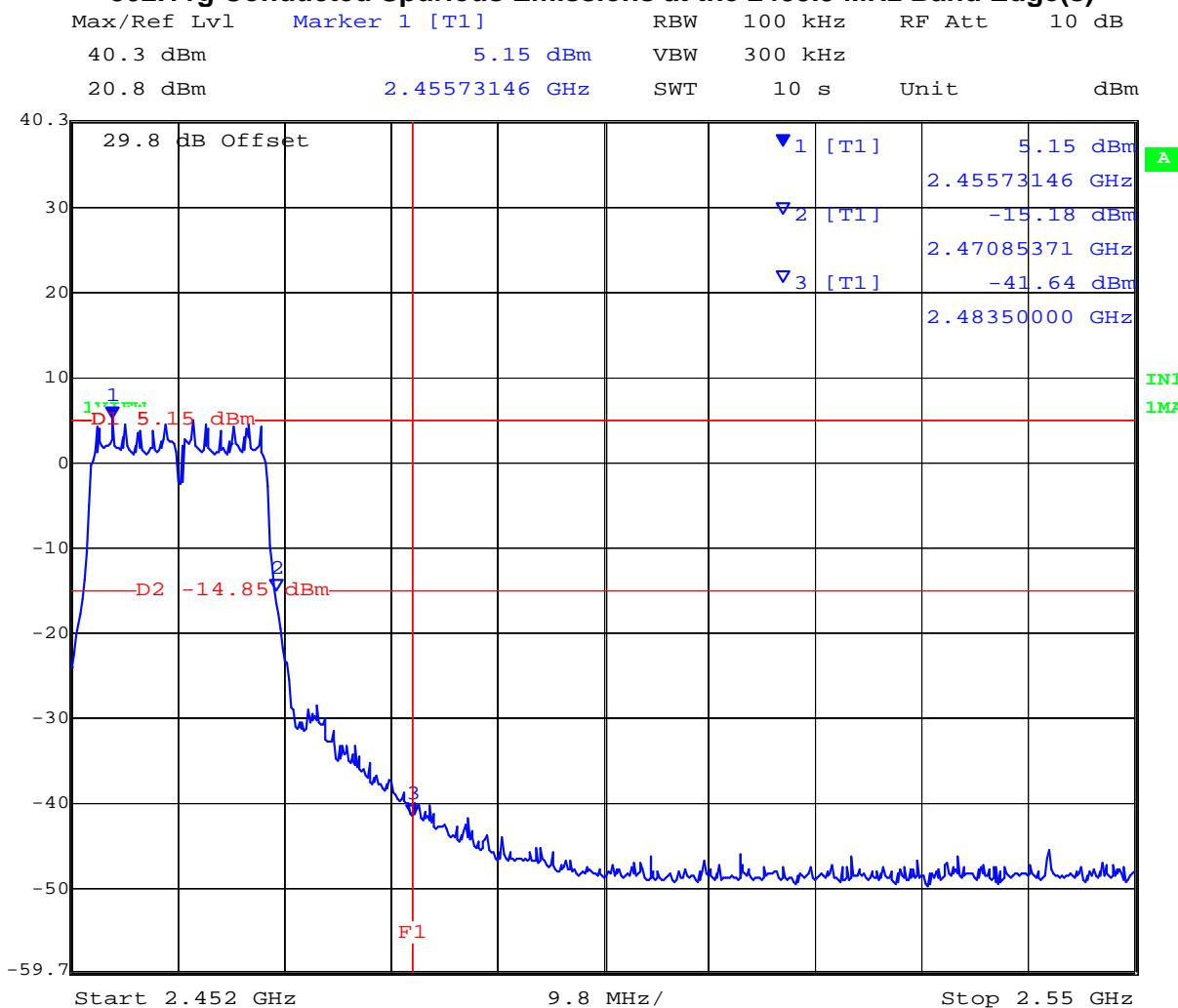
**802.11g Conducted Spurious Emissions at the 2,400 MHz Band Edge(s)**



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### Upper Band Edge

#### 802.11g Conducted Spurious Emissions at the 2483.5 MHz Band Edge(s)

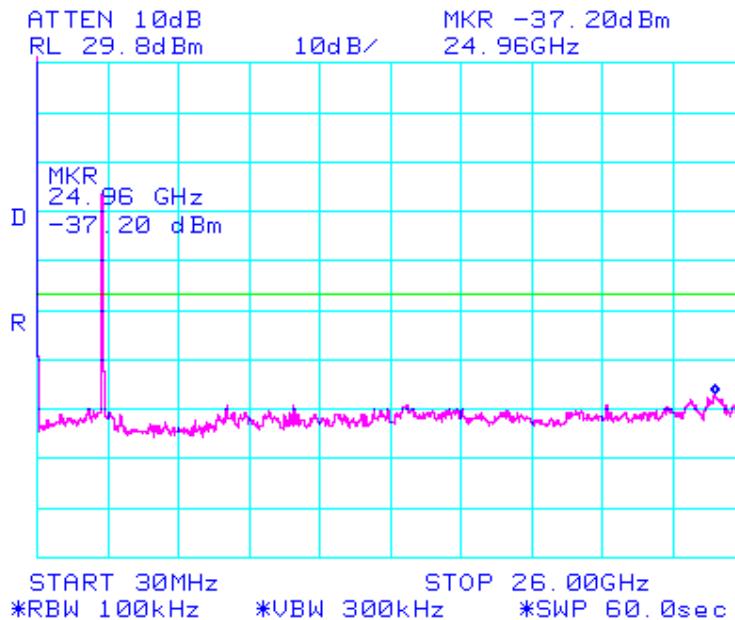


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TABLE OF RESULTS – 802.11g

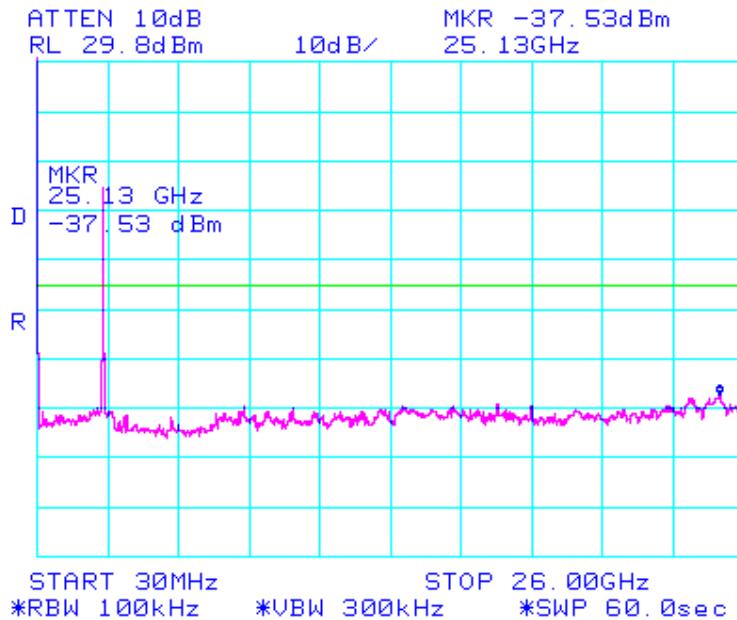
Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2412	30	26,000	-37.20	-14.55	-22.65
2437	30	26,000	-37.53	-14.45	-23.08
2462	30	26,000	-38.03	-14.85	-23.18

**802.11g 2412 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz**

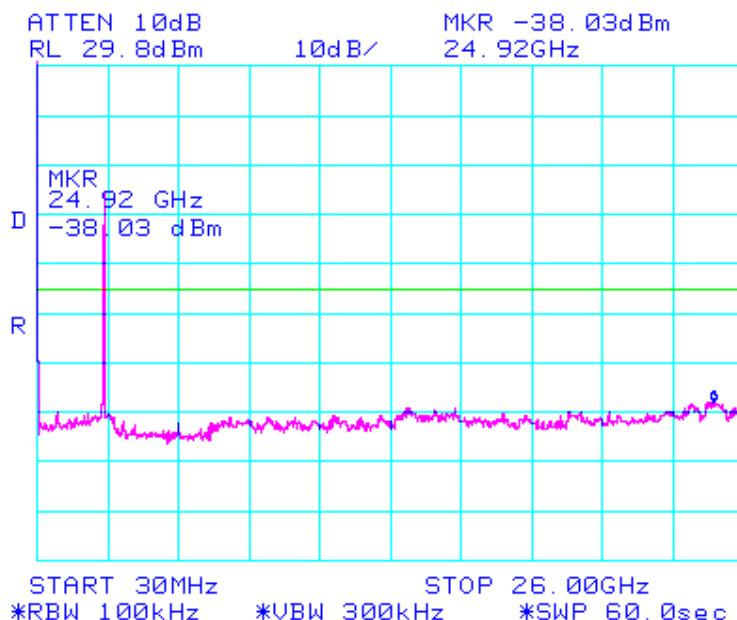


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## 802.11g 2,437 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



802.11g 2,462 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



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## Specification

### Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
2,400 MHz	2,483.5 MHz	≥ 20 dB
5725 MHz	5850 MHz	

**§15.247(d) and RSS-210 §A8.5** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

### §15.247(d)

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

**RSS-210 §A8.5** If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

### RSS-Gen §4.7

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz, whichever is the lowest frequency, to the 5<sup>th</sup> harmonic of the highest frequency generated without exceeding 40 GHz.

## Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB
-------------------------	----------

## Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0088, 0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117.

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### **5.1.6. Radiated Emissions**

#### **5.1.6.1. Transmitter Radiated Spurious Emissions (above 1 GHz); Peak Field Strength Measurements; and Radiated Band Edge Measurements – Restricted Bands**

**FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209**

**Industry Canada RSS-210 §A8.5, §2.2, §2.6**

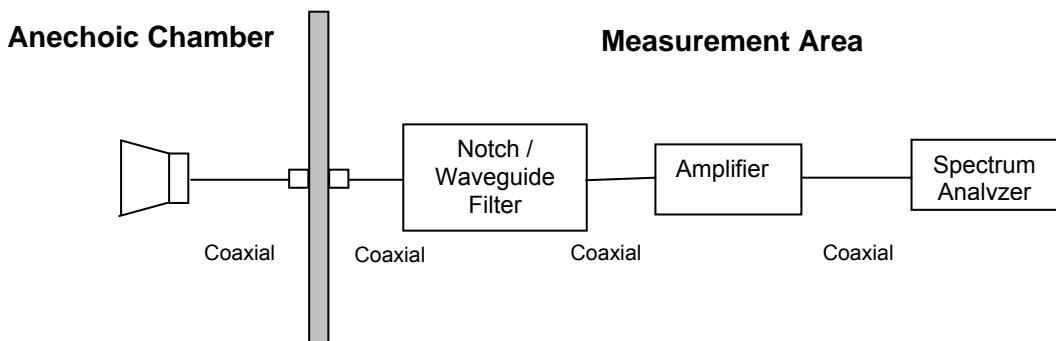
**Industry Canada RSS-Gen §4.7**

#### **Test Procedure**

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

#### **Test Measurement Set up**



Measurement set up for Radiated Emission Test

## Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where: FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss

For example:

Given receiver input reading of 51.5 dB $\mu$ V; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dB}\mu\text{V/m}$$

Conversion between dB $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log} (\text{level} (\mu\text{V/m}))$$

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

## Ambient conditions.

Temperature: 17 to 23°C

Relative humidity: 31 to 57 %

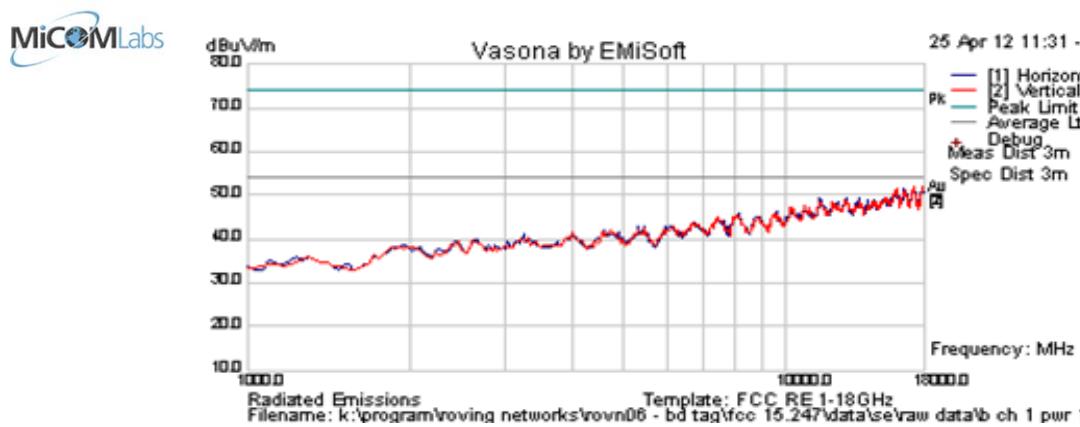
Pressure: 999 to 1012 mbar

---

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## Spurious Emissions

Test Freq.	2412 MHz	Engineer	SB
Variant	802.11b; 1 Mbs	Temp (°C)	24.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum. (%)	39
Power Setting	12 dBm	Press. (mBars)	999
Antenna	integral	Duty Cycle (%)	100
Test Notes 1	S/N: 0012B8BD0410; EUT Vertical Position		
Test Notes 2	3.3VDC; External DC Supply		

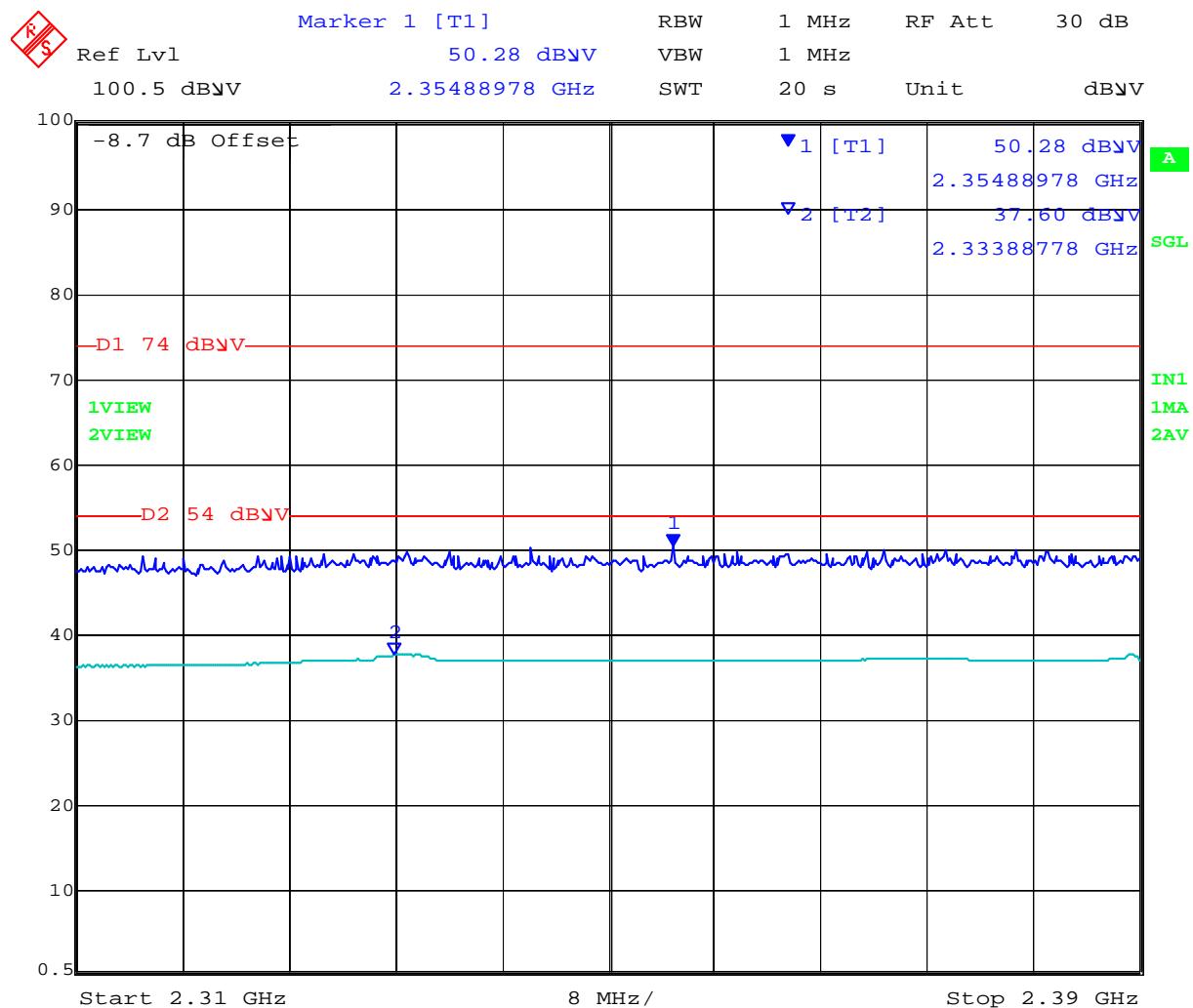


## Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No emissions within 6dB of limit												
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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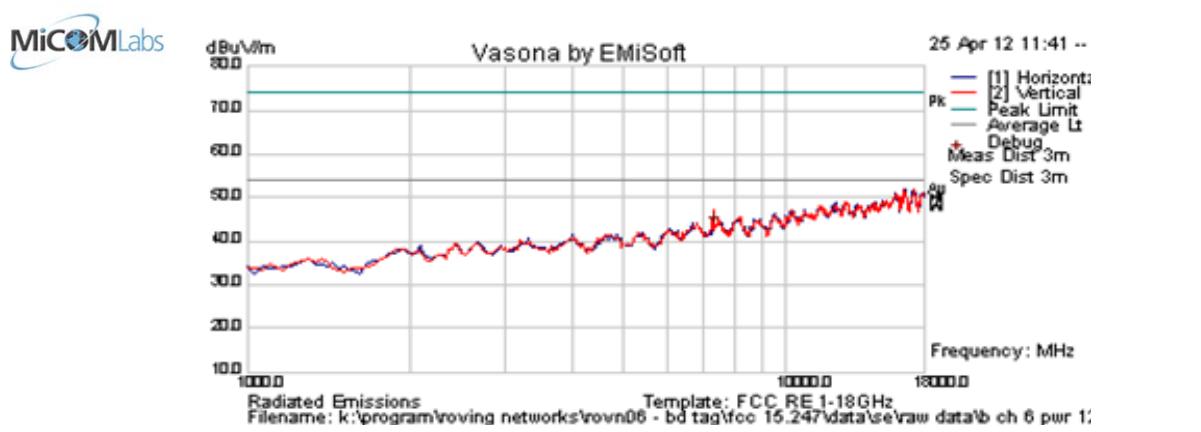
### 802.11b Band-Edge 2390 MHz



Power = 12 dBm

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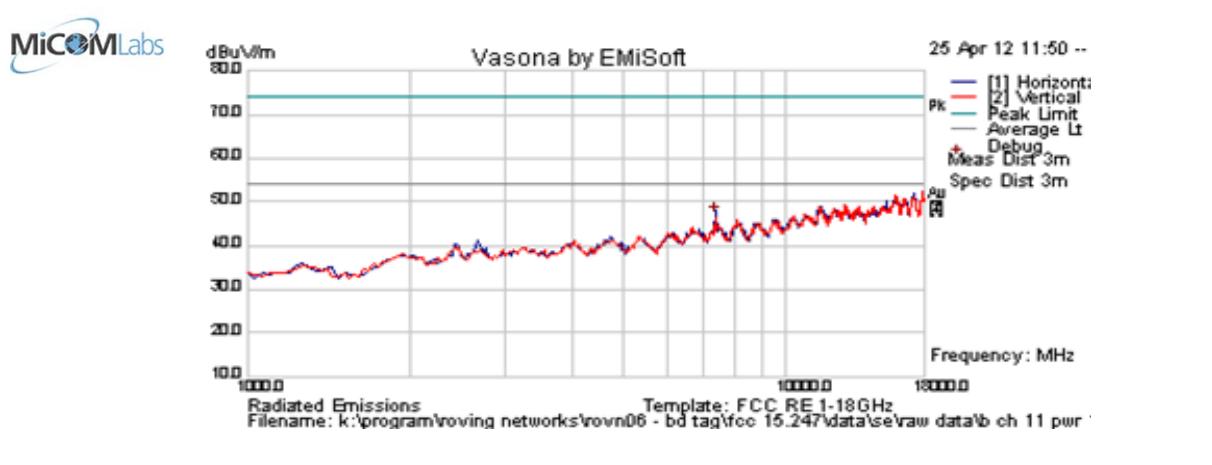
<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	24.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum. (%)</b>	39
<b>Power Setting</b>	12 dBm	<b>Press. (mBars)</b>	999
<b>Antenna</b>	integral	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	S/N: 0012B8BD0410; EUT Vertical Position		
<b>Test Notes 2</b>	3.3VDC; External DC Supply		



Formally measured emission peaks													
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments	
7400.758	43.5	5.5	-5.5	43.5	Peak [Scan]	V	98	0	54.0	-10.5	Pass	RB	
Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission												
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	24.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum. (%)</b>	39
<b>Power Setting</b>	12 dBm	<b>Press. (mBars)</b>	999
<b>Antenna</b>	integral	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	S/N: 0012B8BD0410; EUT Vertical Position		
<b>Test Notes 2</b>	3.3VDC; External DC Supply		

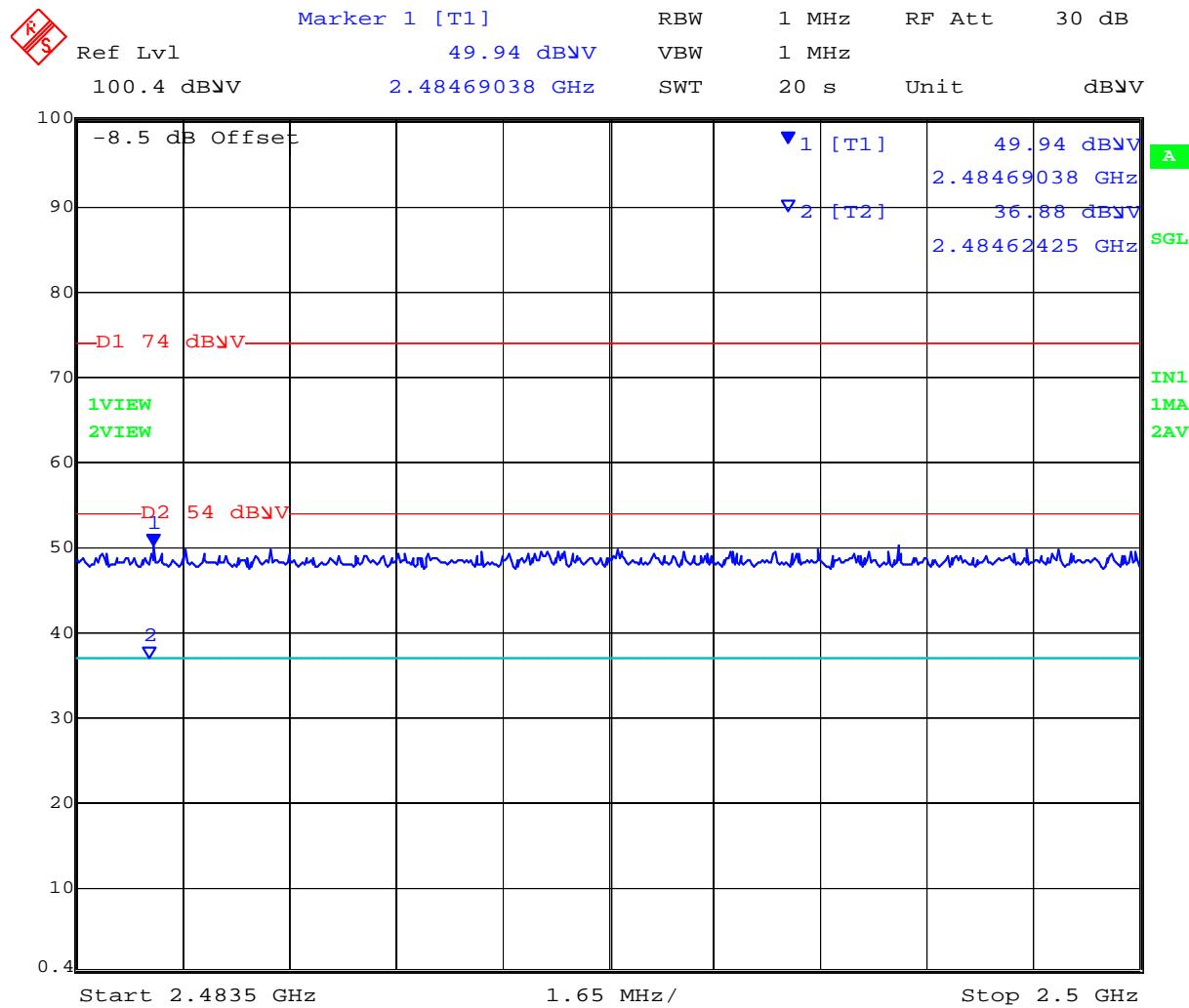


#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7379.429	46.8	5.5	-5.5	46.8	Peak [Scan]	V	98	0	54.0	-7.2	Pass	RB
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission												
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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### 802.11b Band-Edge 2483.5 MHz

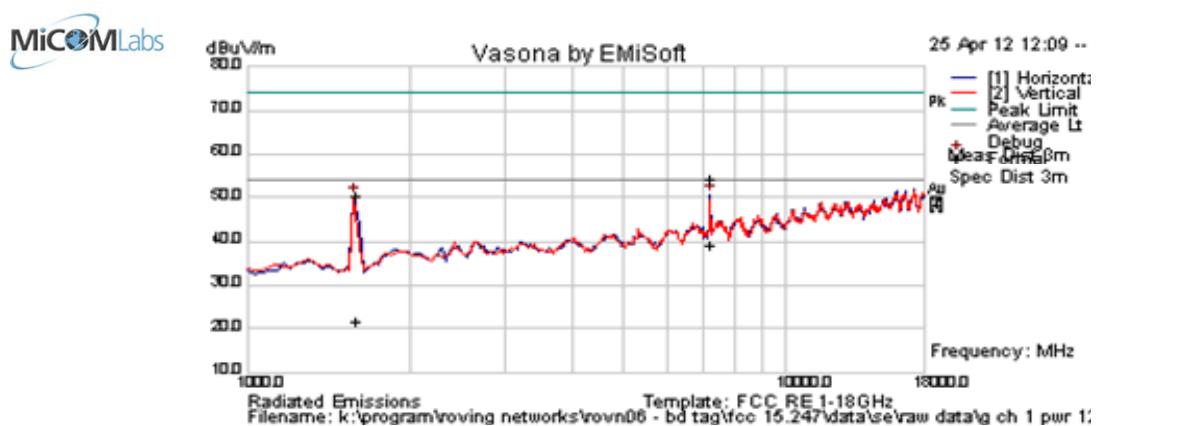


Date: 25.APR.2012 13:22:20

Power = 12 dBm

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<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	24.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum. (%)</b>	39
<b>Power Setting</b>	12 dBm	<b>Press. (mBars)</b>	999
<b>Antenna</b>	integral	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	S/N: 0012B8BD0410; EUT Vertical Position		
<b>Test Notes 2</b>	3.3VDC; External DC Supply		

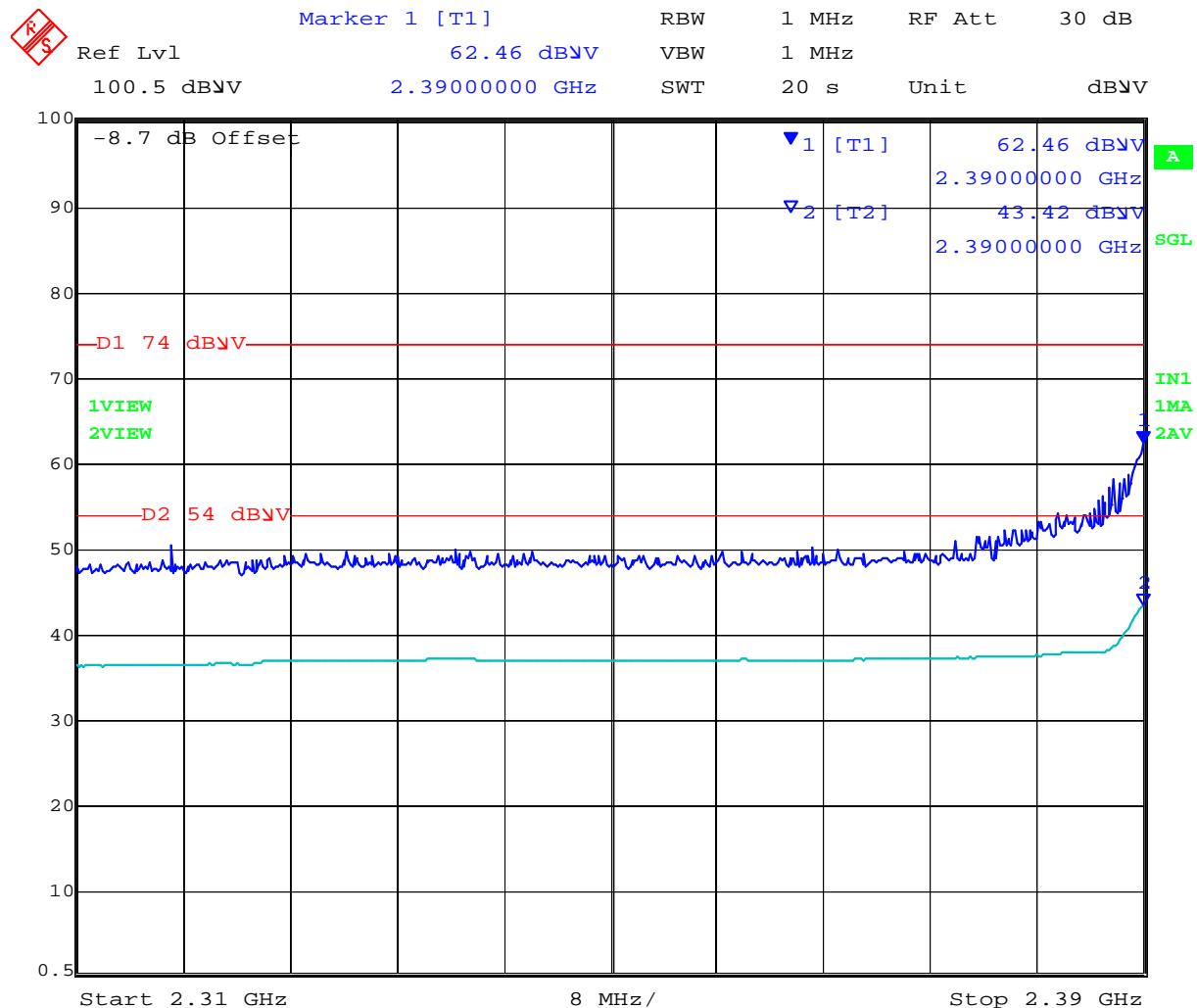


#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7233.988	54.4	5.4	-5.8	54.0	Peak Max	H	149	108	74.0	-20.0	Pass	RB
1596.954	63.0	2.5	-15.2	50.2	Peak Max	V	184	87	74.0	-23.8	Pass	RB
7233.988	39.4	5.4	-5.8	39.0	Average Max	H	149	108	54	-15.0	Pass	RB
1596.954	34.4	2.5	-15.2	21.6	Average Max	V	184	87	54	-32.4	Pass	RB
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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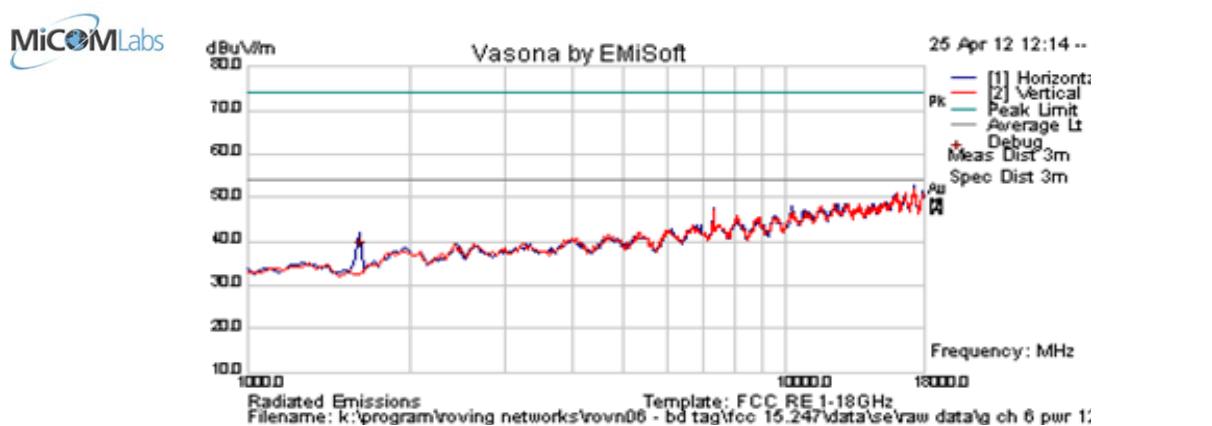
### 802.11g Band-Edge 2390 MHz



Power = 12

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	24.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum. (%)</b>	39
<b>Power Setting</b>	12 dBm	<b>Press. (mBars)</b>	999
<b>Antenna</b>	integral	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	S/N: 0012B8BD0410; EUT Vertical Position		
<b>Test Notes 2</b>	3.3VDC; External DC Supply		

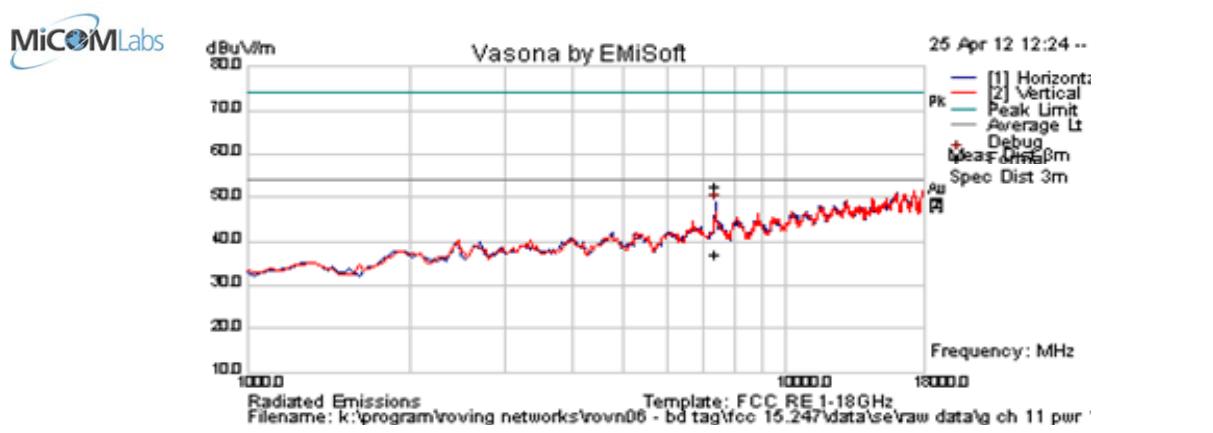


#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1629.825	50.4	2.5	-14.9	37.9	Peak [Scan]	H	98	0	54.0	-16.1	Pass	RB
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission												
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	24.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum. (%)</b>	39
<b>Power Setting</b>	12 dBm	<b>Press. (mBars)</b>	999
<b>Antenna</b>	integral	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	S/N: 0012B8BD0410; EUT Vertical Position		
<b>Test Notes 2</b>	3.3VDC; External DC Supply		

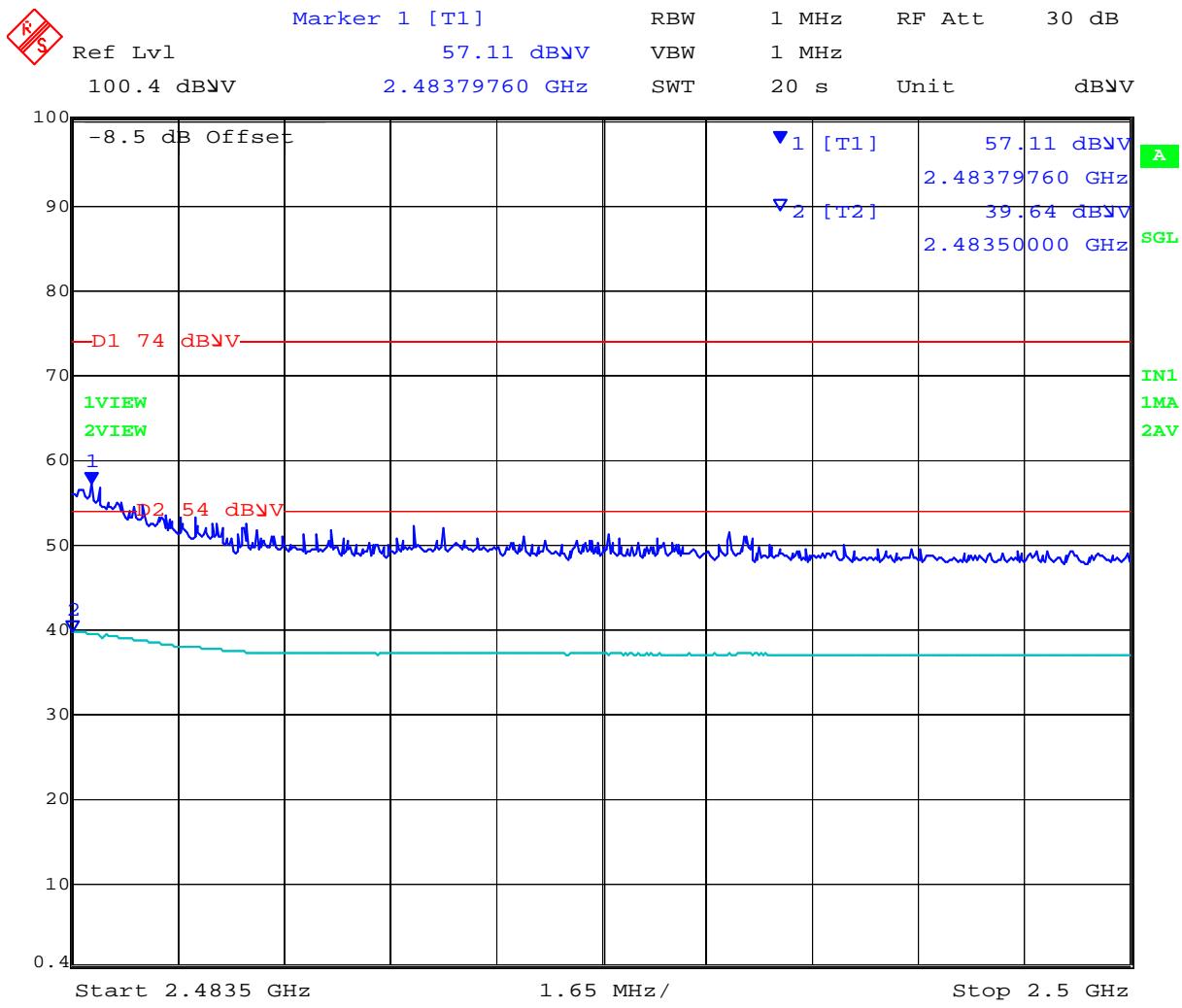


#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7384.689	52.3	5.5	-5.5	52.3	Peak Max	H	113	117	74.0	-21.7	Pass	RB
7384.689	37.2	5.5	-5.5	37.2	Average Max	H	113	117	54.0	-16.8	Pass	RB
Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission											
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak											

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### 802.11g Band-Edge 2483.5 MHz



Power = 12 dBm

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## Specification Limits

**FCC §15.247(d) and RSS-210 §A8.5** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

### **FCC §15.247(d)**

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

**IC RSS-210 §A8.5** If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

### **IC RSS-Gen §4.7**

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz, whichever is the lowest frequency, to the 5<sup>th</sup> harmonic of the highest frequency generated without exceeding 40 GHz.

**FCC §15.205 (a)** Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

**FCC §15.205 (a)** Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**FCC §15.209 (a)** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.



**Title:** Ekahau B4 Wi-Fi Location Tag  
**To:** FCC 47 CFR Part 15.247 & IC RSS-210  
**Serial #:** ROVN06-U1 Rev A  
**Issue Date:** 19th June 2012  
**Page:** 65 of 81

**§15.209 (a) Limit Matrix**

Frequency(MHz)	Field Strength ( $\mu$ V/m)	Field Strength (dB $\mu$ V/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

**Laboratory Measurement Uncertainty for Radiated Emissions**

Measurement uncertainty	+5.6/ -4.5 dB
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**Traceability**

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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### 5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

#### Industry Canada RSS-Gen §4.10, §6

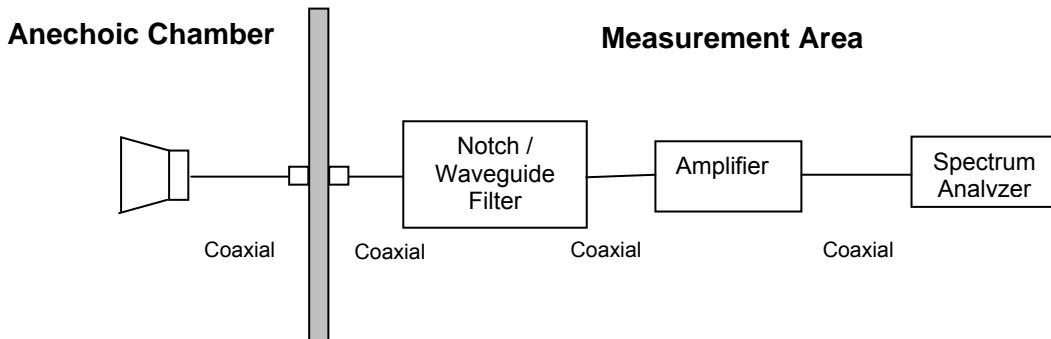
##### Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

All Sectors of the EUT were tested simultaneously

##### Test Measurement Set up



Measurement set up for Radiated Emission Test

##### Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where: FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL - AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss

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For example:

Given receiver input reading of 51.5 dB $\mu$ V; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dB}\mu\text{V/m}$$

Conversion between dB $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as:

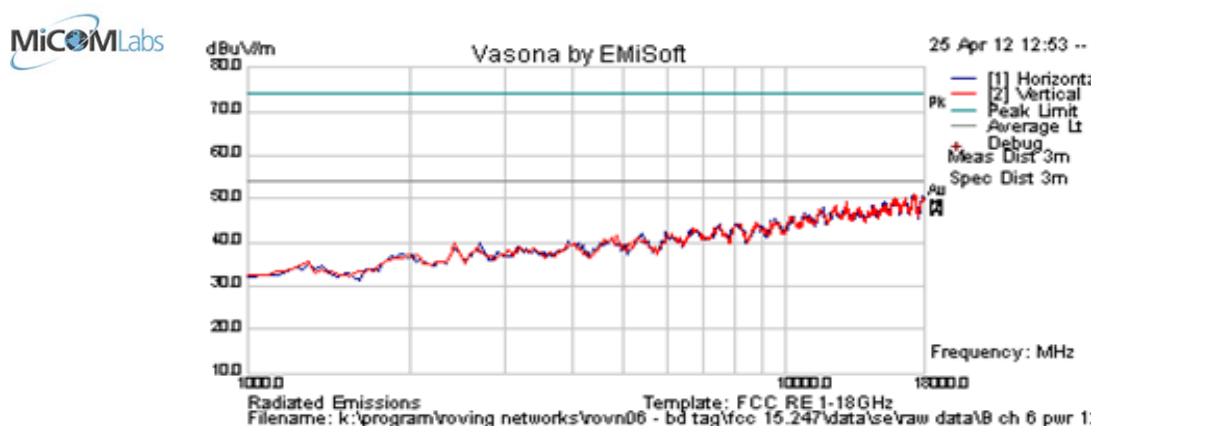
$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log} (\text{level} (\mu\text{V/m}))$$

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

### Receiver Radiated Spurious Emissions above 1 GHz

Test Freq.	2437 MHz	Engineer	SB
Variant	RX	Temp (°C)	24.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum. (%)	39
Power Setting	RX	Press. (mBars)	999
Antenna	inetgral	Duty Cycle (%)	100
Test Notes 1	S/N: 0012B8BD0410; EUT Vertical Position		
Test Notes 2	3.3VDC; External DC Supply		



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No emissions within 6dB of limit												
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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**Title:** Ekahau B4 Wi-Fi Location Tag  
**To:** FCC 47 CFR Part 15.247 & IC RSS-210  
**Serial #:** ROVN06-U1 Rev A  
**Issue Date:** 19th June 2012  
**Page:** 69 of 81

## Specification

### Receiver Radiated Spurious Emissions

#### Industry Canada RSS-Gen §4.10,

The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

#### RSS-Gen §6

The following receiver spurious emission limits shall be complied with;

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1.

Frequency (MHz)	Field Strength ( $\mu$ V/m)	Field Strength (dB $\mu$ V/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

### Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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### 5.1.6.3. Radiated Spurious Emissions (30M-1 GHz)

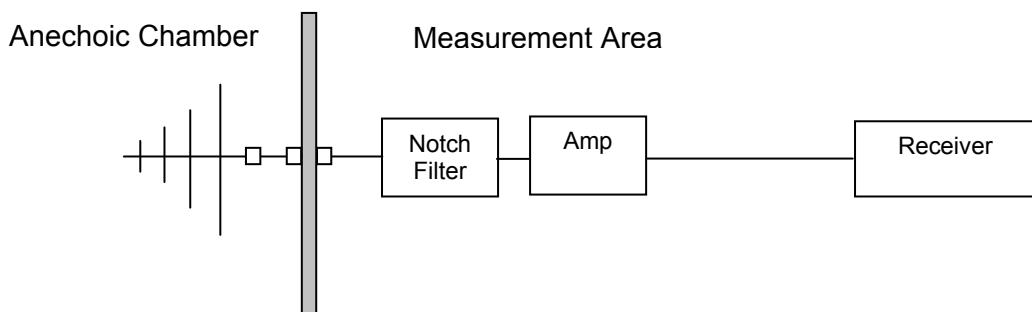
**FCC, Part 15 Subpart C §15.205/ §15.209**  
**Industry Canada RSS-210 §2.2**

#### Test Procedure

Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

The EUT had two methods of powering on ac/dc converter and Power over Ethernet (POE). Both modes were tested for emissions below 1GHz.

#### Test Measurement Set up



#### Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength

R = Measured Receiver Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL - AG + NFL

CL = Cable Loss

AG = Amplifier Gain

For example:

Given a Receiver input reading of 51.5dB $\mu$ V; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3\text{dB}\mu\text{V/m}$$

Conversion between dB $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log (level (\mu V/m))}$$

$$40 \text{ dB}\mu\text{V/m} = 100\mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250\mu\text{V/m}$$

### Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Ambient conditions.

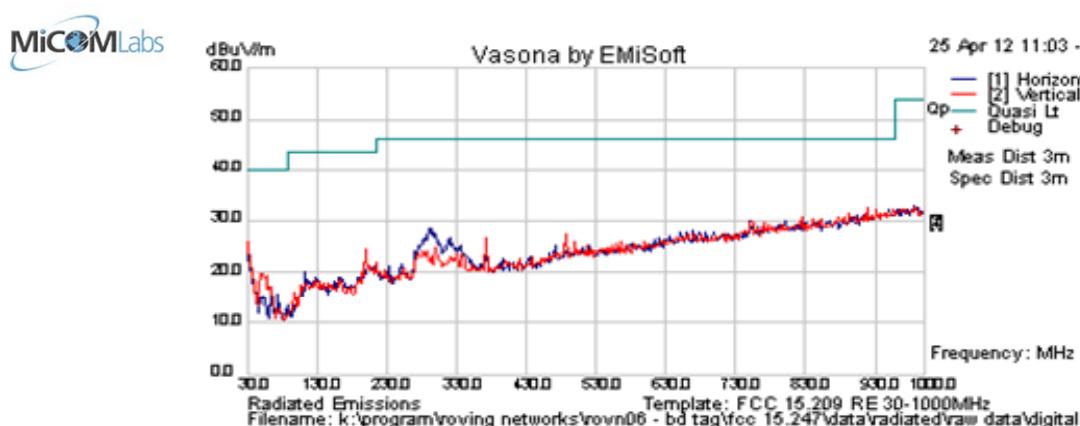
Temperature: 17 to 23 °C      Relative humidity: 31 to 57 %      Pressure: 999 to 1012 mbar

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## TABLE OF RESULTS

Test Freq.	2437 MHz	Engineer	SB
Variant	Digital Emissions	Temp (°C)	24.5
Freq. Range	30 MHz - 1000 MHz	Rel. Hum. (%)	39
Power Setting	12 dBm	Press. (mBars)	999
Antenna	inetgral		
Test Notes 1	S/N: 0012B8BD0410		
Test Notes 2	3.3VDC; External DC Supply		



### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No emissions within 6dB of limit												
Legend: DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band												

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## Specification

### Limits

**§15.205 (a)** Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

**§15.205 (a)** Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**§15.209 (a)** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

### §15.209 (a) and RSS-Gen §2.2 Limit Matrix

Frequency(MHz)	Field Strength ( $\mu$ V/m)	Field Strength (dB $\mu$ V/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

### Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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### **5.1.7. AC Wireline Conducted Emissions (150 kHz – 30 MHz)**

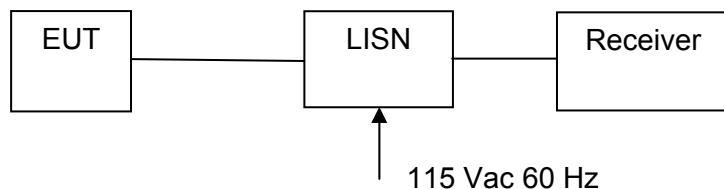
**FCC, Part 15 Subpart C §15.207**  
**Industry Canada RSS-Gen §7.2.2**

**Test not applicable – EUT is battery powered.**

#### **Test Procedure**

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

#### **Test Measurement Set up**



Measurement set up for AC Wireline Conducted Emissions Test

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## Specification

### Limit

**§15.207 (a)** Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu\Omega$  line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

#### RSS-Gen §7.2.2

The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

#### §15.207 (a) and RSS-Gen §7.2.2 Limit Matrix

The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency

#### Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	$\pm 2.64$ dB
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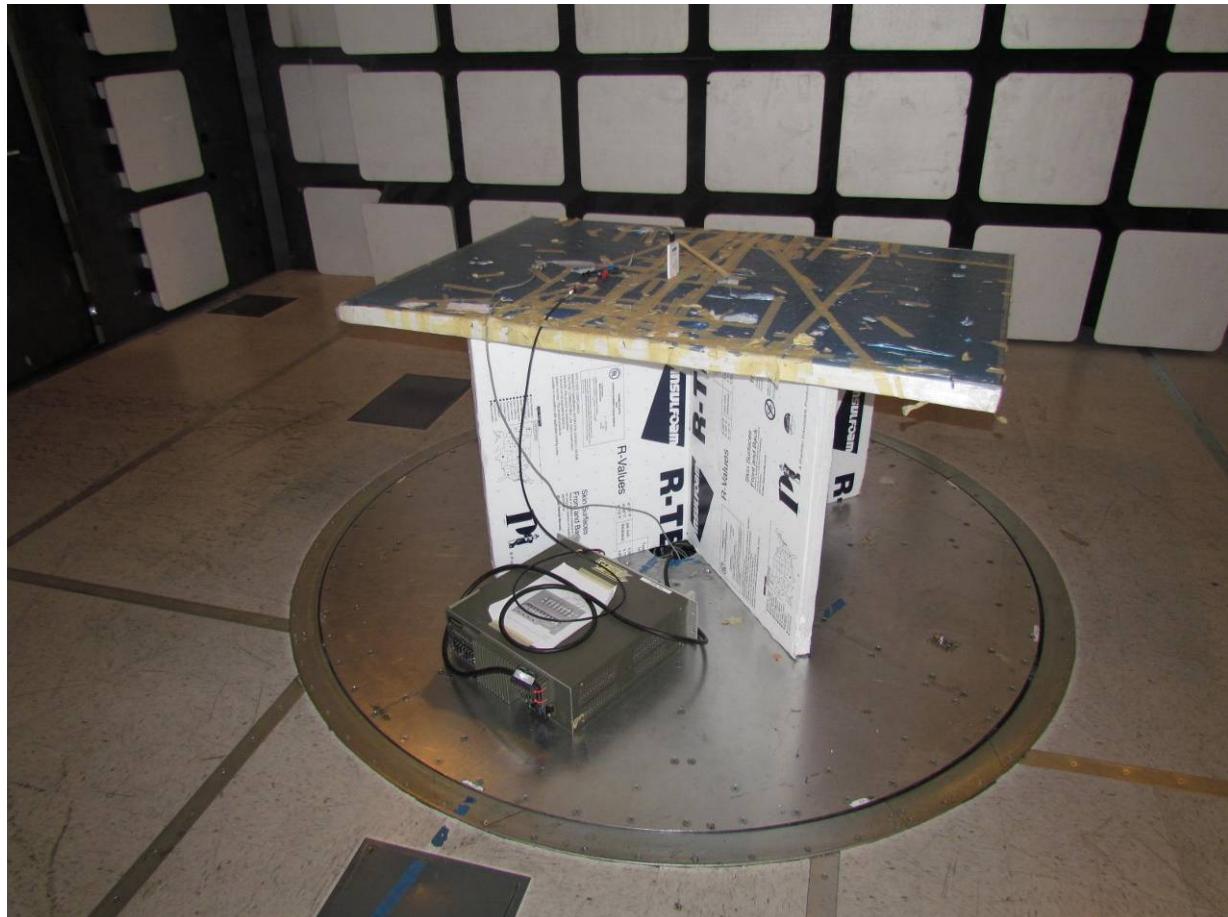
### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0287, 0190, 0293, 0307

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## 6. PHOTOGRAPHS

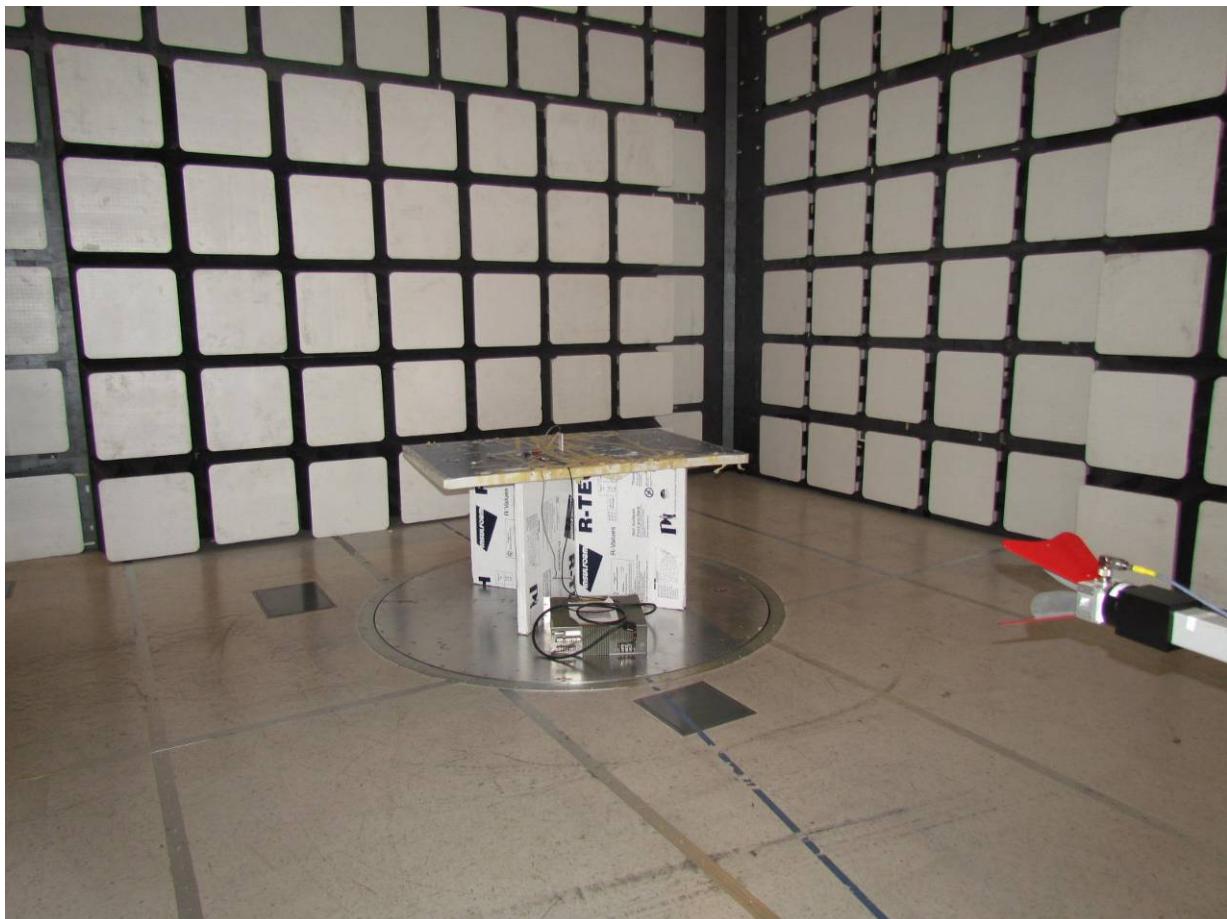
### 6.1. Radiated Emissions Equipment Configuration



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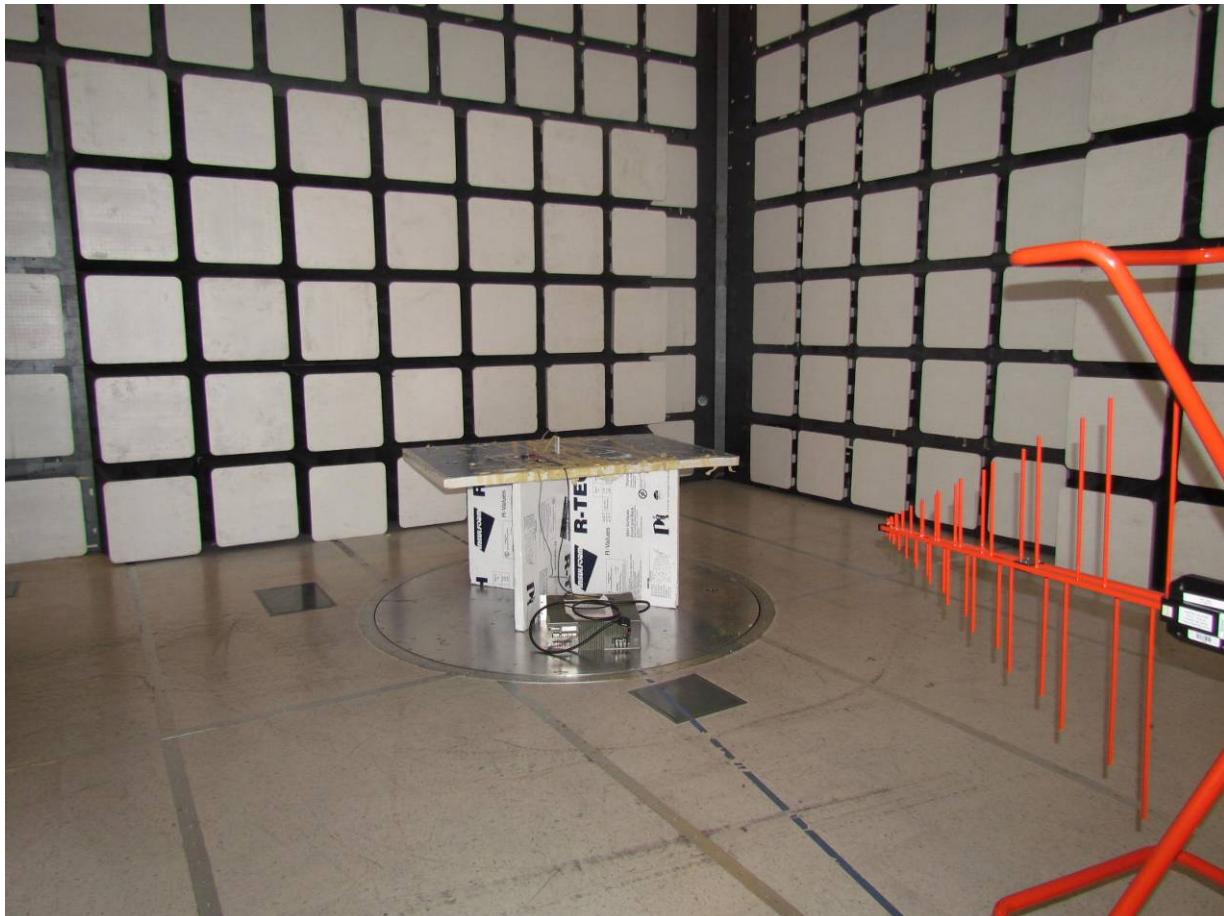
## 6.2. Radiated Emissions > 1GHz



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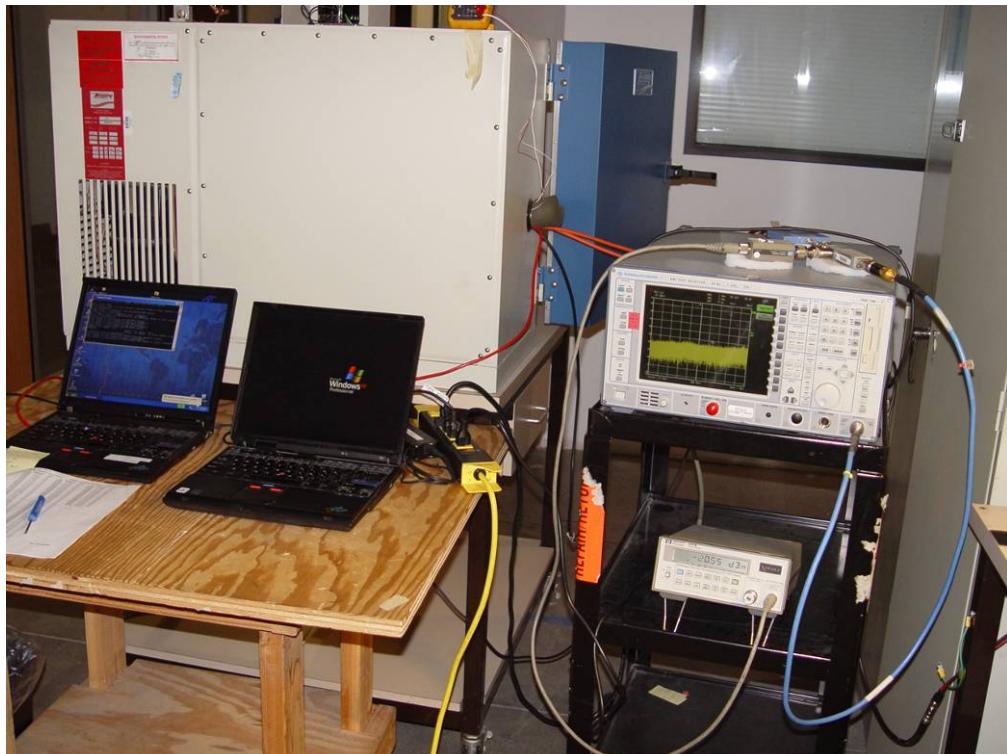
### 6.3. Radiated Emissions < 1GHz



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#### 6.4. Conducted RF Measurement Test Set-Up



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**Title:** Ekahau B4 Wi-Fi Location Tag  
**To:** FCC 47 CFR Part 15.247 & IC RSS-210  
**Serial #:** ROVN06-U1 Rev A  
**Issue Date:** 19th June 2012  
**Page:** 80 of 81

## 7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0287	EMI Receiver	Rhode & Schwartz	ESIB 40	100201
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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